

HEALTH

In Home and Neighborhood



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HEALTH IN HOME AND NEIGHBORHOOD

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PREFACE

HEALTH IN HOME AND NEIGHBORHOOD, like the first book of this series, HEALTH FOR EVERY DAY, is intended to guide boys and girls to healthful ways of living, in accordance with the teachings of modern science and approved educational procedure. But in doing so, it is mainly concerned with the understanding of conditions that make the home, the school, and the neighborhood healthful and sanitary, always with the objective of maintaining personal health.

The teacher, administrator, or school officer will notice that in this book the references to such parts of the body as the heart, lungs, liver, intestines, nervous system, etc., are in general terms rather than technical, and therefore require no scientific description for the application to health covered by this book. Careful analysis of the factors in health teaching in elementary schools has led to the conclusion that, before the upper grades, the scientific study, as such, of the internal organs is a waste of time and in fact dulls the interest. Children should first acquire clear ideas concerning good health and should form correct health habits under the guidance of their teachers and parents.

In this book health is treated as a matter in which there should be coöperation of the persons in the home and also of those in the community. Good health is the objective and for each individual this depends primarily upon the constant practice of good health habits in healthful sur-

roundings. Consequently such topics as water supply, heating homes, the beneficial effects of sunlight, and the relation of ventilation to the healthful adjustment of the human body are discussed.

In the last chapter, Improving Community Health and Welfare, the pupil is shown how he can help make his community healthful and sanitary and how established agencies contribute to that end. A study and investigation of conditions and agencies outside the schoolroom gives the pupil an idea of the efforts being made by society to alleviate human suffering, to help the unfortunate, to improve working conditions, to develop the spirit of community responsibility, etc.

The authors have tried to make this book a real guide for the study and practice of health. It presents numerous problems to be solved by the pupils, and questions to be answered, and suggests projects to be carried out. Before beginning class work with HEALTH IN HOME AND NEIGHBORHOOD, the teacher should turn to the Suggestions to Teachers, beginning on page 316, for a discussion of the educational objectives and methods upon which this book is based and for suggestions for further activity on the part of the pupil. The teacher who makes use of the ideas contained in the Suggestions, will develop the greatest possible interest of the pupils.

The exercises have been carefully prepared with a view to covering all the important points in the text in such a way as to test the child's ability to understand and apply what he is learning. For this important contribution, the authors are indebted to Miss Laura Zirbes, Associate Professor of Education, Ohio State University, who prepared the exercises, assisted by Miss Agnes M. Doster.

Another feature, which the authors regard as of fundamental importance, is the extensive use of the methods of visual education for teaching health lessons. For the most part the numerous carefully chosen illustrations are new to textbooks, and were planned to help carry out the purposes of the book. The legends which accompany the illustrations supplement the text and should be regarded as an integral part of it. It is important, therefore, that the pupils study the illustrative material as well as the text.

Since the teacher of Health needs much supplemental information which only a special teacher has time to glean from the numerous reference books, few of which are available for the average busy teacher, a teacher's manual is provided to help those who use HEALTH FOR EVERY DAY and HEALTH IN HOME AND NEIGHBORHOOD.

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CHAPTER I

OUR FOOD SUPPLY AND HOW WE USE IT

The first book in this series, *Health for Every Day*, has taught you many useful facts and rules which will help you keep your own self healthy, but it told you very little about how every person in the home, the school, and the neighborhood should aid in making the conditions for living and working healthful for everybody. Only selfish persons would want to keep only themselves healthy and not even try to help others.

Here are some cases of persons who were so selfish that they would not help others to keep well. A boy often drank the certified milk which had been bought for the baby, and left only ordinary milk for it. A man of great influence, who lived on a hill in the clean and healthful part of a town, was so little interested in the health of other people that he refused to pay taxes for draining a swamp which affected the health of families in the lower part of the town. Another man in the same town, who had no children going to school, tried to stop the boring of a deep well which was needed to supply pure water at the schoolhouse. A farmer in New York State kept one cow very clean because his own family used her milk, but never washed the other cows, whose milk he sold. A woman in Ohio, who found her little boy stirring

cream in a churn with his boot, exclaimed, "Oh, the butter will do to sell."

These are cases of selfish persons who cared nothing for the health and comfort of other people. They may have been interested in members of their own families, but they would do nothing to make things better for the other people in the town or community.

This book deals with many things that affect the health of everybody in homes, in schools, in shops, in factories, and in every other place in the neighborhood in which we live, work, study, and play. Important topics concerning the health of everybody in a neighborhood are as follows: where and how we get our food supply; why and how we heat and ventilate our buildings; where we get our water supply; how we light our buildings; how we get rid of refuse and sewage; how we prevent the spread of disease germs; how we provide for the recreation of both children and adults; how we can make our homes and neighborhoods more attractive and beautiful; and how the health officers help to keep us in good health.

These topics will be studied in this book. The first lessons are on our food supply, because this is of such great importance to us.

The food supply of our neighborhood. The health of persons living in any neighborhood depends more upon the food supply than upon any other thing. If there is plenty of good, wholesome food, the people are likely to be healthy and happy; but if there is a shortage of food, they soon become disheartened, and

lose interest in their health and in everything else, because they are undernourished. Finally, their bodies become so weakened that they are unable to resist disease germs.

If there is a great shortage of food, there is, of course, a real famine, with all its awful conditions.



FIG. 1. The American Indians stored food for future use. This picture of an Indian storehouse for grain is from an old drawing made in 1564. This storehouse is very different from the huge "elevators" of today which store millions of bushels of wheat and other grains. (*From Carrier's "Beginnings of Agriculture in America," McGraw-Hill Co.*)

There has never been a real famine in our country; but you may have read about some of the terrible ones in parts of China and India, where there have been many famines during the past twenty-five years; or the awful one in Russia after the World War; or the great famine in Ireland caused by the failure of the potato crop. In all of these cases there was plenty of food to feed the starving people in other

parts of the world, but it could not be transported quickly enough to prevent the famine. The chief causes of famines are: (1) lack of proper means for the transportation of foods; (2) lack of places for storing surplus food for future use; and (3) the failure of crops.

If railroads, boats, and trucks should be stopped by a general strike in any of the larger of our American cities, a famine would soon follow. New York City would be without milk within forty-eight hours, and without meats or vegetables within a few days, if hundreds of boats, trains, and trucks were not constantly bringing new food to the city. Perhaps you think the inhabitants of such a city could go out into the country and get food for themselves; but the fact is that only a very small part of New York City's food supply comes from the farms that are within 100 miles. The larger part of the food is brought hundreds of miles by railroad; even a large part of the city's milk is produced more than 100 miles away from it.

You have probably read in books of history that fortified towns have withstood long sieges, but these were towns in which a large amount of food had been stored for the use of a small number of people. In 1870 Paris stood the siege by the Germans for just 127 days. No large city existing today could stand a siege which cut off the food supply for three weeks, because food is not stored in large quantities in any city. Here in America we are accustomed to depend upon a continuous flow of foodstuffs from the places where they are produced. This is the cheapest and

best way of supplying our food needs, provided nothing interferes with the means of transportation.

In this book we are interested in the supply of the right kinds of food to all the homes in the neighborhood; and so we are going to study such topics as: where we get the food supply for our neighborhood; how it is transported; what kinds of foods are best for us; how they are used in the human body; how we prepare foods in order to make them most useful and palatable; and how we conserve or store up foods for future use.

The kinds and sources of food in your neighborhood. What foods are produced on your farm, or within a few miles of your home? Make in your notebook a list of "fresh" or "perishable" foods, such as fresh meat, ripe fruit, and green vegetables, which are used in your own home or sold at the nearest markets. Why are such foods labeled "perishable" when they come by freight or express? Arrange your list of the fresh foods used in your neighborhood like the following one, which gives examples of five foods that were sold at a grocery in a town in New Jersey last spring. Add to your list whenever you find new facts about the food supply in your own neighborhood.

NAME OF FOOD	WHERE PRODUCED	HOW TRANSPORTED
Navel oranges	California	Railroad
Extra early potatoes	Bermuda	Boat and railroad
Radishes	Long Island	Farmer's truck
Oatmeal	Buffalo, New York	Railroad
Whole wheat bread	New York City	Motor truck

When you have kept this list for several weeks, and added to it as many foods as you can find in your neighborhood, compare the number of foods that come from the United States with the number that come from other countries. Are the most common foods produced in this country, or brought here from other countries?

When you have found out where most of the foods used in your neighborhood come from, you will probably notice that, with the exception of common salt, they all come from animals or plants. Can you think of any food that does not come from one of these sources? Can you think of any food that does not come from farms? Here are three which do not — fish, oysters, and salt. Perhaps you can name a few others.

Could people in cities get along without farmers to produce their food supply? What would happen if all the farmers stopped producing food and moved to a town or city? Since the farmers are so necessary to the life of everybody, should they not be properly appreciated by people who live in cities? Do you know any city people who do not understand that, since everybody would starve if the farmers did not produce foods, farming or agriculture is the most important business in America? How do you think this important fact can be taught to people who do not live on farms, and who never stop to think where their food comes from?

We shall now see the importance of animals and plants in producing our food, both on the farms of

America and in those foreign countries from which we get some of our "luxury" foods, such as olives.

Animals as sources of food. Many people live largely on milk, eggs, butter, and meats, and they almost forget that there are any plant foods. In fact, bread is the only plant food some people use. You will learn in a later lesson that every person's daily diet should



FIG. 2. A shorthorn cow. Shorthorns, Herefords, Aberdeen-Angus, and Galloways are breeds of cattle most commonly raised for beef. Jerseys, Guernseys, and Holsteins are good dairy cattle. (*U. S. Department of Agriculture*)

contain some vegetable food, but the purpose of this lesson is to see what foods we get from animals.

The principal foods that we get from the hairy animals, which are called "mammals" in books on zoölogy, are: beef from cattle, mutton from sheep, pork from hogs, and milk from cows. Meat from horses and goats is commonly used in Europe, and Angora goat meat is liked by many persons in the United States. Meat from wild game animals, such as deer, rabbits, squir-

rels, woodchucks, bison or "buffalo," and bears, is regarded as a luxury, "fit for a king," by many persons.

The most important of all these foods from hairy animals is milk. Both children and adults drink it. We use it in bread, soup, pie, pudding, and in dozens of other things we eat. We make butter and cheese from it. The fact is, the cow is the most important animal in America. We could get along without sheep, because we can make clothing without wool. We could get along without horses, because we have motors. We are not obliged to have pigs and sheep, because we can get other meats. But so long as there are children, especially babies, we cannot do without the cow, the producer of the best food for children. The only possible substitute for the cow is the milch goat, but this animal is best adapted to a mountainous country, like Switzerland, and it would probably not be possible to keep enough goats in America to supply the necessary milk. Even in Switzerland, the goats are usually kept in the mountainous regions, where cows could not be kept; but on the farms in the valleys there are numerous cows.

The cow is really a living machine for making milk from plants, many of which humans do not eat. This is why the dairy cow is the most important food-producing animal in America.

Much of our animal food is from birds, especially the tame or domesticated chickens, ducks, geese, turkeys, and guinea fowls. Many wild game birds are sold in the city markets, when the laws permit. What

game birds have you seen for sale, or brought to your town by hunters?

The most important birds which produce foods for humans are chickens. They supply us with a considerable amount of the meat used in our country; and, what is more, they produce eggs, which are a very important part of our food supply.

It is interesting to find out how much food a good hen can produce in a year. Such a hen as an expert poultry man would select for laying eggs may weigh four pounds or more. A five-pound hen will eat in a year 85 to 100 pounds of grain, and also some green food, such as grass in summer, and cabbage or sprouted oats in winter. She will produce from 150 to 240 eggs per year. Each egg weighs about two ounces. Now if you will find the total number of ounces and then change them to pounds, you will find that the good laying hen produces several times her own weight of eggs yearly.

If we ate such a good hen as this, we would have much less than five pounds of meat after removing it from the bones; but the eggs which she produces in a year would give us several times as much of better food. Evidently it is not wise to kill "Biddy" if we are sure she is a good egg producer. Some hens produce less than 100 eggs a year, and some old ones do not lay any eggs at all. Good farmers are learning how to select, for use as meat, the hens which are not likely to produce a large number of eggs.

Fishes are a very important part of our food supply.

Millions of salmon, each weighing 20 pounds or more, are caught every year in the rivers of the Pacific coast of North America, especially in the Columbia. The codfish is the one which is next in importance among American fish. In some years over one hundred million pounds of this fish are caught. Many codfish weigh 12 to 40 pounds, and a giant cod, weighing 200 pounds, was once caught off the coast of New England. The shad is also an important fish, and, in some years, over fifty million pounds of them have been caught. There is danger that the salmon and the shad may become greatly reduced in numbers, because they are so easily caught in nets. There is not the same danger in the case of codfish, because they must be caught with hook and bait, in deep water.

There are many other valuable food fishes along the Atlantic and the Pacific coast, in the Great Lakes, and in the lakes and rivers of the United States. Visit the markets of your neighborhood, and find out what kinds of fishes are for sale. What fishes may be caught within a few miles of your own home? When you visit a public library, look at the pictures of food fishes in Jordan and Everman's *American Food and Game Fishes*.

You may find other animals which are used as food by humans, near your home. Look for oysters, turtles, clams, lobsters, crabs, shrimps, frogs' legs, snails, scallops, and crayfish.

Plants are the main source of our food. Did you ever stop to think how many of our foods come from

plants? Which of the following foods come from plants and which from animals: gelatin, vanilla, sugar, cocoa, tapioca, sago, pickles, spices, peas, beans, spaghetti, bacon, olive oil, raisins, molasses, figs, butter, macaroni, lard, flour, breakfast cereals, and egg plant? Can you name any other plants used as food?

You have learned in nature-study lessons that our common plants of the farm and garden have parts known as roots, stems, leaves, flowers, and, also, fruits, which commonly have seeds. In most plants there is one of these parts that is better for eating than the

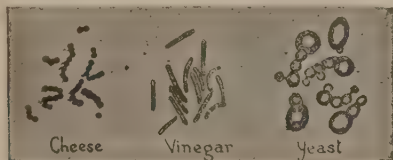


FIG. 3. This picture shows yeast (right) used in making bread, and two other helpful kinds of plants: vinegar bacteria (middle) and cheese-making bacteria (left).

rest of the plant. What part of these plants do we eat: lettuce, cabbage, carrots, beets, spinach, turnips? Sometimes plants have stems that grow underground and look much like roots. White potatoes are really stems of the potato plant, but most persons think they are roots like sweet potatoes. Sugar is obtained from the stem of sugar cane, and sago is made from the stem of a palm tree.

Some fruits, which are the seed cases of plants, are very juicy. Common examples are: apples, peaches,

plums, tomatoes, and oranges. Many other fruits, such as the pods of peas and beans, are not juicy. We eat the seeds of many plants, such as peas, beans, and pomegranates. The Chinese eat the seeds of watermelons. Corn, wheat, oats, and rice look like seeds, but they are really small dried fruits, in each of which is a seed tightly enclosed in the fruit skin. Some oils used as food come from seeds; for example, cottonseed oil, olive oil, peanut oil, and corn oil. Draw lines on a sheet of paper so as to start a table like the one below. Write in the first column as many names of food plants as you can find, and, in the other six columns, mark with "X" the part of the plant which we eat.

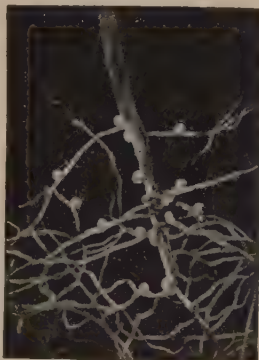
NAME	ROOT	STEM	LEAF	FLOWER	FRUIT	SEEDS
Sweet potato . . .	X	....	....	....	....	....
White potato . . .		X	....	....	....	....
Tomato					X	....
Cauliflower				X	....	....
Spinach			X	....	....	....
Peas						X

When we say that most of our foods come from plants, we do not forget that we eat meat from animals and also some foods produced by animals, such as milk, butter, and eggs. Some of the animals from which we get food, for example, sheep and cattle, feed entirely upon plants, but pigs and chickens are animals which get most of their food from plants, although they do eat worms and insects whenever they

can find them. Do you know why chickens scratch the soil in the garden, and why pigs root in the soil with their noses?

Even those of our food animals which do not live entirely on plants get their food from them indirectly, because the worms and insects they eat have fed upon plants. The same is true of some kinds of fish which feed upon other fish and upon smaller animals, such

FIG. 4. Roots of peas, clover, alfalfa, etc., have growths such as you see in this picture. These are filled with bacteria that add to the fertility of the soil. On that account, soil in which roots with such bacteria have grown, promotes the growth of food plants. In this way these bacteria are useful to animals and men.



as insects and the larvae of mosquitoes; these smaller animals have fed on plants.

These facts, when called to our attention, show that, if we seek far enough for the source of any animal's food, we will find that its food supply comes directly or indirectly from plants. In some cases, a large animal may eat a smaller meat-eating animal, which in turn has eaten a plant-eating animal. For example, a lion may eat a dog, which in turn has eaten a rabbit, which eats plants.

It is true therefore that the food supply for humans comes from plants, part of which we get directly from the plants which we grow in our farms and gardens, and part of which we get from animals whose food is obtained from plants.

It is interesting to note that humans do not care for meat from animals which feed entirely upon other



FIG. 5. Map showing potato production in the United States. (U. S. Department of Agriculture)

animals. Starving people have eaten cats, lions, tigers, and other meat-eating or carnivorous animals. Seals and walrus are meat eaters which are eaten by humans, but the people who eat them live in the far north, where other food is sometimes very scarce. In some cases humans like meat from animals which eat meat as well as plants. For example, many people like pork and poultry, and it is said that some people eat dogs. Everybody knows that hogs and poultry eat many kinds of plant food, as well as many

kinds of animal food when they can get it. However, these animals eat so much more plant food than animal

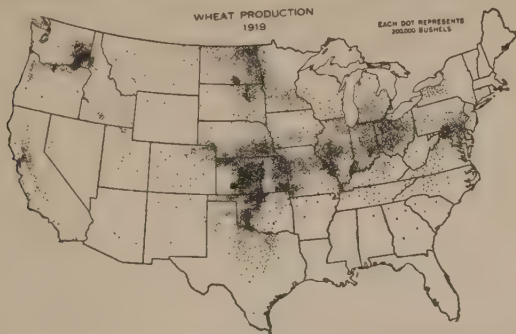


FIG. 6. Map showing wheat production in the United States. (U. S. Department of Agriculture)

food that their flesh is more like that of plant-eating animals than like the flesh of meat-eating animals.

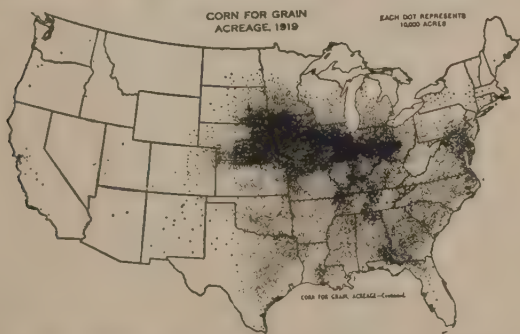


FIG. 7. Map showing corn production in the United States. (U. S. Department of Agriculture)

Since very much of our food supply comes directly from plants, it is both interesting and important to

learn the effect of temperature and rainfall upon the soil in the parts of the country from which we get our various foods. Look at the maps in Figure 5 to Figure 7. How does your state compare with other parts of the country in the raising of potatoes? of wheat? of corn? Since grains make up a large part of the food of cattle and pigs, where would you expect to find that most of these animals are raised? In answering this question, did you leave out any important states given in Figure 7?

Most of our plant foods were first grown in other countries. Look at the table below to see where wheat and potatoes came from. From what continent did tomatoes come? They are now used so commonly that it seems incredible that there are persons still living who remember when tomatoes were thought to be poisonous and unfit to eat. They were cultivated only in flower gardens, and were called "love apples."

Look through the table of food plants and find five food plants from Asia which were introduced into the United States. Find one plant probably used by

TABLE GIVING THE EARLY HOMES OF COMMON FOOD PLANTS

FOOD PLANT	FIRST HOME
Asparagus . . .	Southern Europe and Asia
Barley	Southwestern Asia
Beans	Tropical America
Beet	Countries near Mediterranean Sea
Buckwheat. . .	Northern Asia
Cabbage	Western Asia
Carrot	Holland
Coconut	Islands of Indian Ocean

EARLY HOMES OF COMMON FOOD PLANTS—*Continued*

FOOD PLANT	FIRST HOME
Cucumber	Southern Asia
Indian Corn	Southern part of North America
Oats	Europe and Western Asia
Onion	Persia and near-by countries
Parsnip	Southern Europe and Asia
Radish	Middle Asia
Spinach	Southwestern Asia
Sugar Cane	Eastern Asia
Sweet Potato	America (South?)
Tomato	South America
Wheat	Southwestern Asia
White Potato	Mexico and Pacific countries of South America
Apple*	Eastern Europe, Western Asia
Apricot*	Central Asia, China
Blackberry	United States
Banana*	Southern Asia
Cranberry	Eastern North America
Currant	Northern Hemisphere
Cherry	Asia Minor, Europe
Date*	Arabia, Northern Africa
Fig*	Arabia
Grape, Old World*	Western Asia
Grape, New World	North America
Grapefruit	Malayan and Pacific Islands
Lemon	India
Muskmelon	India, Western Africa
Orange	India
Pineapple	American tropics
Peach*	China
Pear*	Europe and Asia
Plum*	Southern Europe, Western Asia, North America
Quince*	Persia, Turkestan
Raspberries, Red . .	Europe, Asia, North America
Raspberries, Black	Middle North America
Strawberry	North and South America, and Europe
Watermelon*	Africa

* The fruits marked with a star have been cultivated for more than 4000 years.

the Indians before white settlers came to our shores. Write a list of fruits and other foods which we might eat in a day and name the countries or continents from which these foods originally came.

How many of our common food plants came from Europe? Africa? South America?

Vegetarian diet. Plants contain so many of the substances needed to build and repair our bodies that many persons think that we do not need any animal food at all. Cows, horses, sheep, and many other large animals grow to be strong and vigorous on plant food only. There are many persons, also, who keep in good health, although they eat only plant or vegetable substances. There are others who are in the main vegetarians, but who add to their vegetable diet such animal foods as milk, butter, and eggs. This is a very wise thing to do, especially for growing children, because milk, butter, and eggs contain many substances valuable for growth.

Classes of foods. We get our food supply from many kinds of animals and plants; and cooks mix the materials together according to hundreds of different recipes, to make a great variety of "dishes," which are so called because such prepared foods are served in dishes. You know that there are dozens of kinds of bread, cake, pie, cooked vegetables, meats, etc. All the thousands of "dishes" or prepared foods are made of only five kinds of substances, or "classes of foods." These are sugars, starches, proteins, minerals, and fats. Corn starch is, of course, a starchy food.

Honey is a sugar food. In which of the five classes do corn and potatoes belong? Butter, cream, and olive oil are fats. White of egg and lean meat are good examples of protein foods. Nearly every food we eat contains several minerals, such as lime, iron, or sulphur; and we add salt, another mineral, to a large number of foods we have on our tables.

The sugar we buy is practically pure, but most of the articles of our diet contain more than one of the classes of food. White potatoes are mainly starch, but they contain valuable protein and minerals, as well. Beans and peas are mainly starch and protein. It is the minerals, proteins, and sugar, in milk, that make it an important food for every one, especially for growing children. Eggs are rich both in fats (the yolk) and in protein (the white).

Tests for foods. There are several tests which chemists apply to find the kind of materials of which our different foods are composed. One of the most interesting of these is the test for starch. This test is also one of the easiest to make.

The test for starch. Make some starch paste by mixing a little water and starch (corn starch or laundry starch) together. Then drop into it two or three drops of iodine, which you may purchase at any drug store. Notice the bluish or blue-black color that appears. If the blue color is not very distinct, add a little more iodine.

If we had time to try many experiments, we might test other substances, such as powdered chalk, and

confectioner's sugar for starch. Chemists have made such tests hundreds of times, and they have never found any substance but starch which will turn blue when iodine is added. Hence, chemists have decided that iodine, if dropped into any food mixture, will turn it blue if starch is present.

How can we find out whether or not there is starch in food? Cut a slice of white potato, and drop a little

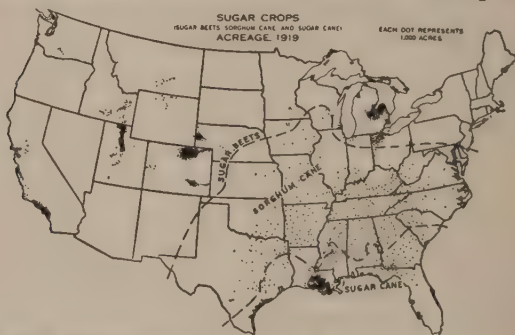


FIG. 8. Map showing sugar production in the United States. (U. S. Department of Agriculture)

iodine on it. Wait a few minutes to give the iodine time to act on the starch. Does potato contain starch?

Try the iodine-starch test with white of egg, cooked oatmeal, milk, bread, a lump of sugar, and a piece of cabbage or turnip? Which of these contain starch? Is there at least one which does not contain starch?

Tests for sugar. The tests for sugar are not so easy to make as are the ones given for starch and for fat. Our sense of taste, of course, shows us the presence of some sugars, such as the fruit sugar in grapes and

in prunes, and the sugar from cane and beets, which we use on our tables. Young beets, peas, carrots, and corn are sweet because they contain sugar. We do not need to test honey or melons to know that they also contain sugar.

Most drug stores keep on hand a blue liquid, called Fehling's solution, which is used in testing foods for some sugars. It is used especially with those foods which do not taste sweet, or in which there is only a small amount of sugar. When this blue liquid is heated in a glass tube with such a sugar as glucose or corn sirup, a red-yellow substance forms.

Boil a few raisins or prunes in a small amount of water, in order to extract some of their sugar. Now add a few drops of the blue liquid, heat it, and notice the color that appears. What does this color show?

The test for fats. There are many kinds of fats in our foods, and chemists have to make a different

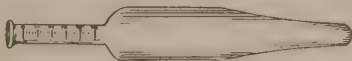


FIG. 9. Good milk has at least three per cent butter fat. If milk is put into a special tube like this, and then whirled around rapidly by a special machine, the fat collects at the top. The marks indicate the percentage of fat in the milk which is being tested.

test for each of them. Most of these tests are not easy to make or to describe; but there is a very simple one which shows whether fats are present in many of our foods, especially when these foods have been warmed or heated a little before the test was made.

Drop a little lard, butter, or olive oil on a clean

piece of paper, and notice the greasy transparent spot which appears. Rub the kernel of a walnut or a Brazil nut on paper, in the same way, to see whether it contains any fat. Is there more fat in cream than in milk? How can you find out?

A test for protein. Since most of the tests which chemists use for protein are quite difficult to make, we shall use only a very simple one. You may usually find out, however, whether or not there is much protein in any one of your foods, by applying this test.

Feathers and hair contain protein substances. Hold a hair or a feather in a flame, such as a candle or a gas burner, and notice the odor given out as it burns. Most burning proteins give off a disagreeable odor like this. Now, burn a little sugar on the end of an old knife or strip of tin, and note how different the odor is. Try starch or butter the same way. Next, try the burning test with other foods, and see if you can distinguish the ones containing protein by the odor they give out. Hold a piece of lean meat, or cooked white of egg, on an old hatpin or wire, while you burn it in a flame. Is the odor like that of the burning hair or feather?

A test for mineral foods. A very simple experiment will prove that even the water we drink contains minerals. Find a piece of clear, thin glass, and wash it clean; then put a drop of water on it, and warm the glass over a flame until the water evaporates. A whitish spot on the glass will show where the water was. We can prove that the whitish spot is made

of minerals, because it does not burn up or disappear if we heat it in a flame. (Use a gas or alcohol flame.)

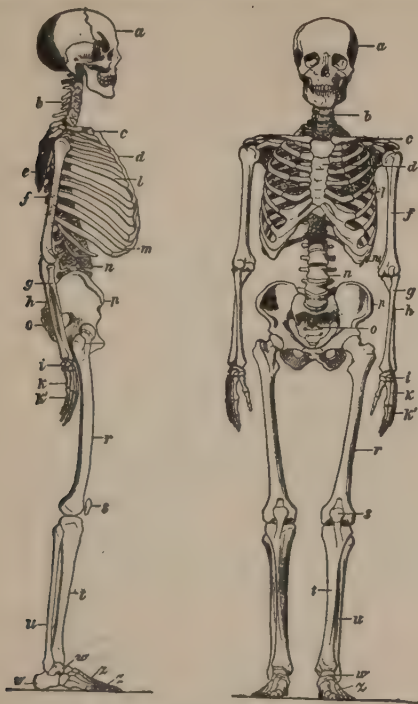


FIG. 10. Mineral foods are necessary for all living parts of the body, but especially for the bones of young and growing persons, whose skeletons may increase in size until the age of 21 to 25 years is reached.

If you want to know the names of the chief bones and then try to find them in your own body, this key to the letters on the pictures will help you: *a*, skull; *b*, neck or cervical vertebrae; *c*, clavicle; *d*, sternum; *e*, scapula; *f*, humerus; *g*, radius; *h*, ulna; *i*, wrist bones; *k*, hand bones; *l*, ribs; *m*, sternal cartilage; *n*, vertebrae; *o*, coccyx; *p*, pelvis; *r*, femur; *s*, patella or knee-bone; *t*, tibia; *u*, fibula; *v*, heel; *w*, ankle; *z*, foot bones.

When some foods are burned in special pieces of apparatus, such as chemists' white porcelain dishes, we get mineral ashes, just as we do when we burn grass or wood. These mineral ashes can be tested by a chemist to find whether they contain lime, potash, sulphur, or iron. In this way we can learn whether the foods which we are eating contain all the different kinds of mineral food we need in all the tissues of the body, especially in the bones of the skeleton.

Our daily diet. In our daily food we should have some of each of these five classes of food materials: sugars, starches, proteins, fats, and minerals. Study this list of common foods to find out what classes of food materials you get when you eat milk, potatoes, brown bread, and the other foods named in the table.

FOODS	PROTEINS	SUGARS	STARCHES	FATS	MINERALS
Granulated sugar		X			
Salad oil . . .		. .		X	
Table salt . . .		. .			X
Oranges . . .		X			X
Potatoes . . .	X		X		X
Meats . . .	X			X	X
Honey . . .		X			
Milk . . .	X	X		X	X
Eggs . . .	X			X	X
Butter . . .				X	
Whole wheat bread	X		X		X
Fish . . .	X			X	X
Bacon . . .	X			X	X
Cocoa . . .	X	X		X	
Marmalade . . .		X			
Dried beans . . .	X		X		X
Watermelon . . .		X			

Food substances that stimulate growth. Recently, it has been discovered that many of our foods contain a sixth class of food substance called vitamins. These vitamins are necessary for life itself. One of the reasons why milk, eggs, fruits, and vegetables are so necessary for good health is that each contains one or more of these vitamins.

We were a long time finding out that there are such substances as vitamins, because they cannot be seen, even with microscopes. Nor can we test foods for vitamins as we test them for starches or for fats, etc. The way we usually find out whether or not a vitamin is present in a food is by feeding it for several weeks to animals. By such experiments it has been discovered that cream contains a vitamin that stimulates growth. Chickens which were given skim milk without cream did not grow so well as those which had milk with cream. Then the chickens which had not grown well were given some cream and they began to grow faster; but they never became as strong and healthy as the chickens which had been fed cream from the beginning. The conclusion drawn from this experiment was that cream contains a vitamin which stimulates the growth of chickens.

The rats shown in Figure 11 were used in a similar feeding experiment. They were given exactly the same amounts of a food mixture, but one rat had a small amount of chopped cabbage leaves added to its daily diet. That rat grew much more rapidly and was much more lively and vigorous when this picture

was taken about three weeks after the feeding began. This experiment shows that cabbage leaves contain vitamins necessary for growth.

We know as yet very little about the nature of vitamins, and about how much of each one we need for growth and to keep us well, but we do know that we should eat, every day, several of the foods which



FIG. 11. Except for one of the vitamins, these two rats had the same kinds and amounts of food. Can you tell which rat did not have the vitamin? (Courtesy of Dr. Mary S. Rose)

are known to contain vitamins. If you will eat each day a fruit; a leafy vegetable, such as cabbage, spinach, kale, or lettuce; another vegetable such as carrots, tomatoes, green beans, or green peas; and drink a quart of milk, you will be sure to have enough vitamins in your diet.

Uncooked plant foods, such as fruits, celery,

cabbage, and tomatoes, contain more vitamins than the same foods cooked, or heated in canning. So some raw plant foods should be eaten every day.

Vitamins, however, cannot keep us well if we do not select our other foods wisely; if, for example, we eat too much sweet food, too much or too little of the protein foods or of the other classes of foods.

Protein in our diet. Our bodies are made of millions of little cells, each of which is chiefly composed of protein. The protein foods are the ones used for the growth and repair of the cells of our bodies. Growing children need more protein in proportion to their size than persons who have completed their growth. It is not wise to eat more protein foods than we really need for growth and repair. Eating too heavily of such foods causes the kidneys to overwork. And, since there are several serious diseases which are caused by kidneys which do not work properly, or which are disordered from overwork, all persons who wish to be healthy limit the protein in their diet, especially the meats, to the amount needed for growth and repair. Eggs and milk contain proteins and also valuable minerals and vitamins. Therefore, it is not necessary to use meat as a source of the protein food needed for repair and growth.

We get our energy from food. The steam engine gets its energy from coal: the automobile gets its energy from gasoline. We could burn corn, wheat, fat, sugar, or dried meat in a small steam boiler, and so get the stored energy out of the food and with it run a toy

steam engine. When we eat and digest such foods, the parts digested are taken into the muscles and other parts of the body, and there burned by a slow process which requires no more heat than the usual temperature of the body. As these foods burn by this slow process, they furnish the energy necessary to work our muscles, and all other organs of our bodies, and to supply the body with heat. In short, food supplies energy for the work and heat of our bodies.

Chemists have found out how much energy or power to do work there is in a pound of coal or a pint of gasoline, by burning these fuels in special apparatus which registers the amount of energy in them. They have done the same with our foods, and they have found that an ounce of fat has twice as much energy as an ounce of pure sugar, starch, or protein. The energy in food or fuel is said to be "stored energy."

No engine can get all the energy out of its fuel and likewise the human body cannot get all of the energy out of its foods. The amount the body does get is called the "available energy" of food.

Food for heat and work. Since we should eat only enough protein for repair and growth, we should supply energy for the heat and work of our bodies by eating other kinds of food. Sugars, starches, and fats are such energy-giving foods.

How much of such foods do we need? An engineer knows how much coal it will take to heat the boiler

of the building in his charge; and a motor-car driver can tell you how much gasoline he will need to drive his car fifty or one hundred miles. How much food does it take to keep our body heated to its normal temperature (98.6° F.)? How much is needed to give us enough energy to walk to school, to play games, to study our lessons, to digest our food, and to do our daily work or chores?

Chemists have answered such questions. They have found ways of measuring the energy for heat and work which the human body can get from foods, just as they can measure the energy in gasoline which can be used to heat a stove or drive an engine. They have determined the amount of energy, in the form of heat, in a cord of wood, a ton of coal, a gallon of gasoline; they have also found out just how much energy there is in a pound of bacon, a quart of milk, and in other definite amounts of various foods.

In measuring the amount of energy in fuels and foods, chemists have used a unit of measure called "calorie." This is the amount of heat necessary to raise the temperature of a liter (about a quart) of pure water one degree on the Centigrade thermometer. (Figure 72.)

If a certain amount of food when burned in the chemist's apparatus will raise the temperature of five liters of water one degree, it is said to have five calories. By this method chemists have found the number of calories in a given weight of each of our common foods, and by other experiments chemists have found out how many calories we need each day.

How to figure your calories. The table on this page will show you how many calories there are in a number of our most common foods. You will find it interesting to read this table to see how much food of different kinds it takes to make 100 calories.

TABLE OF CALORIES IN SOME COMMON FOODS

FOOD	CALORIES	FOOD	CALORIES
a banana, orange or apple	100	cottonseed oil	100
a prune (small)	15	peanut butter	75
a bunch Concord grapes	90	whipped cream	50
a peach	30	oleomargarine	100
a pear	50	brown sugar	35
a soda cracker	25		
a corn muffin	120	one teacup of	
a baking powder biscuit	30	whole milk	170
a slice of bread	50	buttermilk	90
a baked potato (medium)	100		
a piece of mince pie	250	one teacup (cooked)	
a serving of ice cream	200	creamed turnips	200
a small cookie	20	rice pudding	400
a hamburg steak ball	75	oatmeal	100
a fish ball or a lamb chop	100	stewed tomatoes	60
an egg (white, 15; yolk, 55)	70	custard	300
one tablespoon of		string beans (buttered)	100
butter	110	apple sauce	250
American cheese (grated)	16	scrambled eggs	400
thick cream	70	mashed potato	220
olive oil	100	sliced beets	75
orange juice	6	creamed onions	250
granulated sugar	60	succotash	300
powdered sugar	45	pea soup	160
		spinach	65

A child ten to twelve years old needs every day about 30 calories for each pound of its weight. If a boy weighs 60 pounds, he will need 1800 calories of

food each day. How many will a boy weighing 70 pounds need? How many do you need?

If a boy weighing 60 pounds should eat nothing but milk, how much milk would it be necessary for him to take each day, in order to fill all of his energy needs? how much butter, if he ate only butter? how much bread? (See table on page 30.)

Refer to the Table of Calories in Common Foods and select a diet for the three meals of one day for a boy or girl weighing 70 pounds. Allow 30 calories for each pound of body weight. A girl who weighed 60 pounds, figured her calories for one day as follows:

BREAKFAST	CALORIES	DINNER	CALORIES
1 teacup milk	170	1 teacup milk	170
1 teacup cooked oatmeal	100	1 lamb chop	100
1 egg	70	1 baked potato	100
1 tablespoon butter	110	1 serving ice cream	200
1 slice bread	50	1 pear	50
1 orange	100		
Total	600	Total	620
LUNCHEON		FOR THE DAY	
1 cup pea soup	160	Breakfast	600
1 tablespoon butter	110	Luncheon	590
1 corn muffin	120	Dinner	620
1 fish ball	100	Total for one day	1810
1 apple	100		
Total	590		

Did this girl figure her calories correctly? Did she select enough vegetables? There would be no danger to the girl's health if on some days she selected food giving her even 2000 calories, provided she took an abundance of exercise.

Find out how many pounds you weigh, and then select your diet for one day, allowing 30 calories for each pound of your weight.

The energy in our food comes from sunlight. You have learned that all our food comes from plants or from animals which feed chiefly upon plants. This means that, directly or indirectly, all our food comes from plants. Now, the experts in plant physiology have shown in their laboratories that the stored energy in the parts of plants which we use as food comes from sunlight. The power which makes sugar and starch in the leaves and other green parts of plants is in sunlight. When you study chemistry and plant biology in high school or college you will learn many interesting facts regarding the action of sunlight on green leaves, whereby sugar is made, and which the plant in turn uses in making the starch, fat, and protein that we get in food from plants.

Differences in amounts of food needed. A definite amount of food is used, as we have learned, to furnish the energy needed in breathing, in digesting food, in keeping our blood circulating, and in doing other work in our bodies. No matter how little we may move or exercise, we must have a certain amount of food merely to keep the body alive. If a boy weighing 60 to 70 pounds should do nothing more than lie quietly in bed, he would need from 700 to 900 calories every twenty-four hours.

The harder we work or exercise, the more food we use, just as a motor car uses more gasoline in going

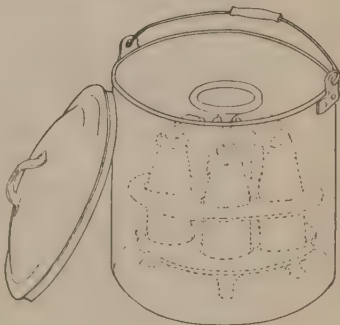
up a hill than in traveling the same distance on level ground. Compare the number of calories needed for sleeping, sitting, etc., as given in the following table.

CALORIES NEEDED EACH HOUR FOR A BOY OF
60-70 POUNDS

Sleeping	30- 35 calories
Sitting	36- 42 calories
Standing	45- 52 calories
Walking	60- 72 calories
Light exercise	75-100 calories
Heavy work	100-150 calories

Why we cook foods. Most of the foods we serve on our tables are cooked in some way. Sometimes we cook foods in order to make them “keep” until we are

FIG. 12. Milk for the baby may be pasteurized at home in a special pail like this one. The temperature should be kept at 140 to 145° F. for thirty minutes.



ready to use them; canning and preserving are really ways of cooking foods.

A second reason for cooking some foods is to make sure that they are free from disease germs or bacteria, such as those which cause tuberculosis or typhoid fever.

Pasteurizing milk may seem like cooking it, but pasteurized milk does not taste very much like boiled milk, or any other kind of "cooked milk." Pasteurizing milk means, however, heating it enough to kill any disease germs which may have entered it from cows, from the persons who milked them, or from those who handled the milk. When oysters, clams, and other shell fish grow in impure water, they may

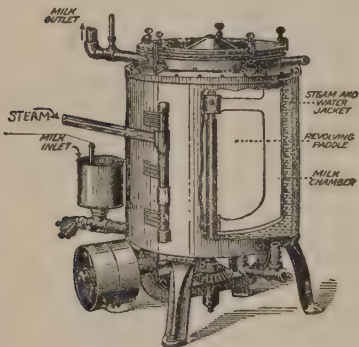


FIG. 13. In dairies milk is sometimes pasteurized in big tanks. The milk is placed in a container inside of the tank. It is heated by steam and at the same time is stirred constantly by paddles which turn like the ones in an ice cream freezer. (After U. S. Dept. of Agriculture)

carry disease germs, such as those of typhoid fever or of dysentery, to us. For this reason it is much safer to cook such food before eating it. Pork, also, should be cooked very thoroughly, because pigs sometimes have a disease caused by worms, and these may be in the meat when we eat it and give us the same disease, as you will learn later.

A third reason for cooking some foods is that it improves their flavor, or makes them more easily digested. Some foods, such as apples, celery, lettuce, radishes,

and cucumbers are eaten raw; but many others, such as rhubarb, spinach, green beans, and peas we do not like except when cooked. If you want to test how much cooking improves the flavor of some of our foods, try eating uncooked spinach, asparagus, oatmeal, or eggs.

Cooking also softens many of our foods, and makes them more easy to digest. Compare cooked and raw



FIG. 14. The lenses in a compound microscope (Figure 15) magnify just as this simple lens or reading glass does. There are several such lenses in the tube of the microscope. You will understand how they work together if you try this experiment. Hold another reading glass over this picture to see how it magnifies the five letters *gnifi*, which were magnified before by the lens shown in the picture.

turnips, rhubarb, or string beans, to see how much cooking softens them.

The microscope may be used to show how much cooking changes some of our foods. The potato, for example, can be seen, with the microscope, to be made

up of millions of tiny boxlike cells, each of which holds many minute starch grains. (Figure 16.) It is necessary to break these cells open before we can digest the starch. When we chew our food, we crack and crush some of these boxlike cells, and so get the starch out of them, just as we get the nuts out of a peanut

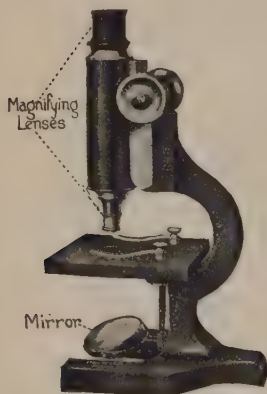


FIG. 15. This microscope has two or more magnifying lenses both at the bottom and the top of the long tube. If we want to examine any small object, we place it on a piece of glass as in Figure 3 and we turn the mirror so that light passes through the object and on up through the lenses in the tube to our eye. Objects seen through microscopes of this kind may look several hundred times larger than they really are. (*Courtesy of Spencer Lens Company*)

by breaking the shell. But the potato cells are so very small that it would be impossible for our teeth to crush them all; and so in cooking potatoes, the starch grains swell until the cells burst open. Have you ever noticed how soft and fluffy the middle of a well-baked potato is? Not only is each cell broken, but also every little starch grain in it has become swollen and softened, so that we can digest cooked potato much more easily than raw potato. In popcorn and puffed rice, the cells and their starch grains are broken in a similar manner.

Ways of cooking foods. The main ways of cooking foods are boiling, steaming, broiling, frying, and baking or roasting.

Foods that have been broiled, or fried, or baked, or roasted are all alike in one way: the outside becomes browned, and it has new flavors which are very pleasing.

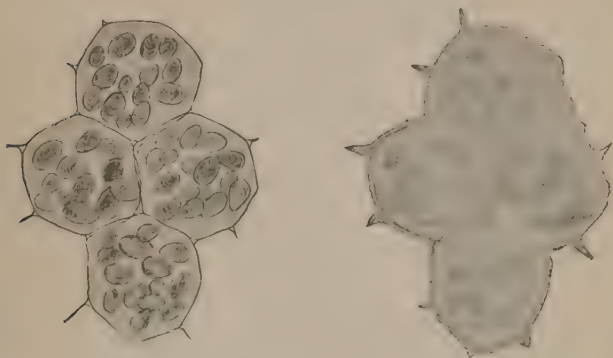


FIG. 16. The left-hand drawing shows the starch grains in several cells of a raw white potato. Cooking bursts the cells and softens and bursts the starch grains. If the piece on the right had been cooked a little longer you would never think that each cell had contained many little separate grains.

When a food is boiled, some of it is drawn out into the water in which it is boiled. You must surely have learned this yourself, if you have ever boiled beets, for the red juice of the beets stains the cooking water a deep red. We make use of this fact in making soup, as in doing so we want to draw the minerals, juices, etc., out of the meat and vegetables. Sometimes we put a food into cold water and heat it very

gradually, so as to draw out most of its juices before the heat has hardened or made tough the outer surface of the food. We may, instead, cut or chop the materials into very small pieces so that the cooking water may come into contact with the greatest possible surface of the food and draw out more of the juices; or we may cook the food a very long time, to make it separate into small parts.

In boiling potatoes, carrots, asparagus, etc., we lose food substances which pass into the cooking water, unless we save this water for making soups. Some housewives use the water in which peeled potatoes have been boiled to mix with the flour used in making bread. A good housekeeper will try to use the water in which vegetables have been cooked whenever possible, as a large part of the very best materials in them — the most pleasing in flavor and the most helpful for growth — passes out into the cooking water. If you have ever tasted chopped meat after it has been cooked thoroughly for the purpose of drawing out the juices for "beef broth," you will know this from experience, and you now see the reason for it.

Is there any good reason for throwing away the liquid when we open a can of peas, beans, spinach, tomatoes, etc.?

When vegetables are cooked by steaming over boiling water, much less of the juice is lost than when they are boiled in water. A number of years ago, there was a fad, especially in England, for "paper bag cooking." Meats and vegetables were tied into paper

bags, after being cleaned; and then placed in a sieve or strainer over boiling water, or in a baking dish inside the oven, until cooked.

Meats and fish should be broiled over a hot fire, so as to sear or cook the outer surface quickly, and

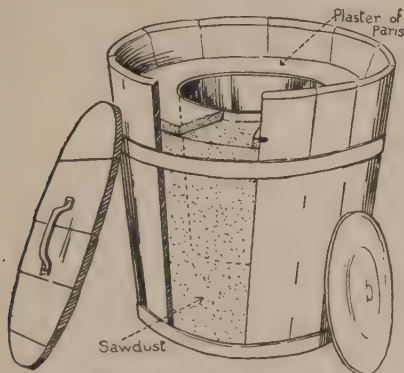


FIG. 17. A simple fireless cooker can be made by placing in a butter-tub, or even in a wooden box, a metal can and then packing dry sawdust, dry shavings, or ground cork between the tub and the can. There should be tight fitting covers for both the tub and the can. More heat will be kept in if a pad is placed over the metal cover. A layer of plaster of Paris holds the sawdust in place and keeps out dust.

so keep the inner juices from being lost. We lose a good deal of the fat, in broiling meats, because it melts and drips out. In frying meats, the fats melt and stay in the pan, of course. In frying mush, potatoes, doughnuts, or crullers, we should heat the butter, lard, or cooking oil, before putting them into the pan, and cook them quickly. If we fry food very slowly, or for a long time, it takes up, or absorbs, a great deal of the fat in which it is cooked. Foods

when fried, are usually not so healthful as if cooked in other ways, because they are harder to digest. Foods such as boiled potatoes, which are otherwise very easily digested, may become much more difficult to digest if they have been covered with a layer of melted fat. This does not mean that we must never eat fried foods; it does mean, however, that we should keep two things in mind: (1) we should form a taste for other kinds of cooking whenever that is possible, for example, for boiled instead of fried eggs; and (2) fried foods should be cooked as quickly as possible, so that they will not become soaked or covered with a thick layer of fat.

Baking or roasting food in a hot oven keeps in most of the juices, just as broiling does, when properly done. In baking the juices stay in potatoes, macaroni, etc., and so are not lost. Juice which runs out of the "roast" of meat is used to "baste" it, and helps to make a good-flavored crust, or it may be used to make gravy.

Special ways of cooking. Many of our cooked foods have special names, such as "scalloped" eggs or oysters, "stewed" tomatoes, "creamed" carrots, and "grilled" chops. "Scalloped" food means really baked or roasted food. Which of the other three foods just named are boiled foods? Which one is a broiled food?

Sometimes, instead of boiling food until it is done, the food is heated very thoroughly, and then taken off the stove and put into a "fireless cooker," where it is kept very warm, almost boiling, for a long time.

This is, of course, merely a way of boiling or stewing food very slowly. Some kinds of fireless cookers are so lined with metal that flat stones heated very hot may be put into them. In these, bread, cake, and meat may be baked, as in an oven.

Pressure cookers are sometimes used. These have very tight-fitting covers, and, when the water in them boils, the steam is held "under pressure," and becomes very hot, i.e., the temperature of the steam held "under pressure" is higher than that of steam from water boiling in an open vessel. This hotter steam cooks the food much more quickly than could be done by ordinary boiling. In our homes, these pressure cookers are used for canning certain foods which require a high temperature for a short time.

Salt in cooking. Many persons eat too much salt, pepper, and other spices with their foods. Too much seasoning of any kind spoils the natural flavor of a food; and it may also lead us to eat more of the food than our body needs. Cooks do not agree about the proper time to add salt to food when it is cooking. If the food is in a large piece, such as a roast of meat, or if the potatoes you are boiling are large ones, unless the salt is added at the beginning, the salt will not penetrate to the inner parts. If we use a small amount of salt only, there is probably no advantage in adding it to the food when we put it on to cook. Too much salt draws some of the water out of food. Did you ever notice how the skin of a cucumber has wrinkled after it has been soaked or pickled in brine (very

salty water)? Why would it be better to salt the food at the beginning when we are making a stew or a soup?

Methods of preserving foods. We have already spoken of the use of heat for preserving foods, as in the canning of fruits. "Cold" is also used for preserving foods, not only in our house refrigerators, but also in cold storage plants and "refrigerator" cars. Pickling in vinegar or salt brine is used to preserve some foods, such as cucumbers and some meats; and drying is another way of preserving some fruits and vegetables.

There are, then, four common methods of food preservation which are widely used today: heating, cold storage, pickling, and drying.

Heat in food preservation. Preserving foods by the use of heat has been in use for over a hundred years, ever since Appert, a Frenchman, in 1804, invented a means of heating foods to make them "keep" for the use of armies, and for use during long sea voyages. Appert's way of canning foods is the one that is now called the "cold pack method." He filled cans with the food he wished to preserve, hammered in the corks very tight, stood the cans in a boiler of water, and then boiled them for a long time. He thus cooked the food, and, at the same time, killed all the molds or bacteria present and so prevented their growing and spoiling the food later. When food is sterilized by heat in this way, it keeps for years. Several cans of meat, lost in a shipwreck, were found, over forty

years afterwards, in such good condition that they were eaten with safety.

Many persons preserve foods by cooking them and then putting them into cans which have been heated in boiling water, to kill the germs inside. In this way the cans are "sterilized" before the cooked food is put into them. Appert's method of filling the cans before the heating is begun has come into common use in America. Can you explain why this is called "the

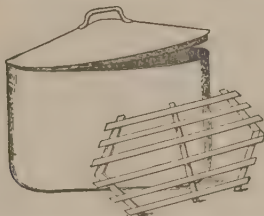


FIG. 18. A washboiler makes a good "sterilizer" for canning. Wooden slats or wire frames in the bottom help to keep the heat away from the cans and prevent their breaking, as they often do when they touch the bottom.

cold pack method"? Even in this method it is best to heat or "sterilize" the cans first. Why?

Sometimes the germs that spoil foods are very difficult to kill. This is often the case with bacteria from the soil, which are very likely to be on such vegetables as corn, beans, etc. In order to make sure that these bacteria are killed, foods are sometimes heated two or three different times after they are put into the cans. But handling the cans several times makes a great deal of work, and canning factories find that method too expensive. They therefore use

special steam boilers, in which the temperature is much higher than that of water boiling in an open vessel.

Steam pressure canners. The pressure cookers or canners often used in homes (Figure 19) will give you a good idea of the pressure cookers used in canning factories. They have doors or lids that fit air tight or steam tight, and when the water in these containers is heated, the steam becomes very hot indeed,

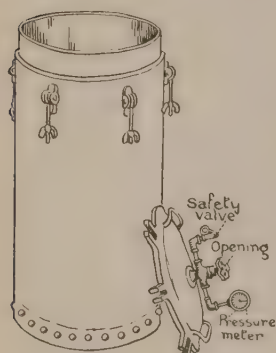


FIG. 19. Water is put into the bottom of this pressure cooker and cans of fruit are then placed in it on a strong rack or support. This cooker can be heated on a stove. When the cover is clamped on tight the steam can be heated until its temperature is much higher than the temperature of water boiling in an open vessel.

hot enough to kill any bacteria and molds that may be in the food in the cans.

Cold temperatures for food preservation. We all know that milk and other foods keep in an edible condition for a longer time in cool places, such as a cellar, a springhouse, or a refrigerator, than they do in warmer places. Foods, like milk, in which bacteria can grow very rapidly must be kept as cool as possible. The milk should be put next to the ice, instead of on one of the shelves of the refrigerator.

Why? Eggs, fish, and other meats are often kept for months in huge cold storage buildings. And many foods that used to be cooked or dried to preserve them are now frozen. In some parts of our country, bakers now buy cherries and other fresh fruits, and eggs (without the shells), which have been frozen in buckets.

Notice the express and the freight trains, when you pass near railroads, and you will see many refrigerator cars which are carrying fresh fruits and vegetables from a great distance — even across the United States.



FIG. 20. These drawings of three drops of milk show how differences in temperature affect the growth of bacteria in milk. If a drop of milk had one bacterium at the beginning of the day, by noon it might have five if kept in the refrigerator; but it would have a great many more than five if left in a warm room — even more than are shown in the right-hand drop.

Home ice refrigerators. We usually have ice refrigerators in our homes. Heat, as you know, will melt the ice, when it reaches it; and the faster the ice takes heat from the air or from the food in the refrigerator, the faster it is melted. This is what we mean when we say that the warmer the air or the food in the refrigerator, the quicker the ice is melted. Ice boxes have thick walls, usually double ones, filled in between with loose charcoal, cork, or mineral wool. The air in the filling and in the spaces surrounding it keeps the heat from the outside air from getting into the air

in the refrigerator rapidly. Very hot foods should be cooled before putting them into the refrigerator, so that they will not "waste the ice." Food, however, will not be cooled unless the ice takes its heat, and this, of course, melts the ice. If the food is to be cooled and kept cool, the ice has to melt. Some persons who do not know this wrap the ice in paper, to

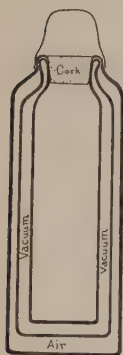


FIG. 21. Vacuum bottles have an outer covering made of metal. Inside of this covering is a double-walled glass or steel bottle; the air has been pumped from the space marked "Vacuum" in the picture. A vacuum prevents the passage of heat more than an air space does. Therefore hot foods will lose heat slowly and cold foods will gain heat slowly.

keep it from melting. The result is that the ice is kept from taking as much heat away from the food in the ice box as it would if not wrapped in paper.

The only ways by which we can really "save ice" are these two: (1) buy a good ice box, with walls which do not let heat get through them very fast, and tight doors to keep the cool air in and the warm air out; and (2) keep the doors of the ice box closed except when it is necessary to put in or take out foods, and then keep the doors open as short a time as possible.

The temperature of the air near the melting ice in a good refrigerator is 38° to 45° F. The temperature in the part where the food is kept is usually several degrees warmer. The cold air surrounding the melting ice is heavier than the air below it, and therefore settles down, while the air below which has been

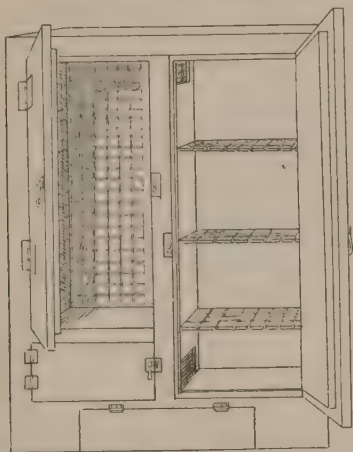


FIG. 22. Notice the openings at the top and bottom of the partition in the refrigerator. Through these openings the air can circulate. The space between the double walls of the refrigerator is filled with cork or charcoal, and has therefore many small air spaces, as in a fireless cooker.

warmed by contact with the food is lighter and is pushed up by the colder air above, or as we say, "rises." This causes a constant circulation of air in good refrigerators which have partitions and holes so arranged that cold air from the ice chamber can settle down and the warmer air below rise to the top of the refrigerator. Look at Figure 22.

Try to find in your neighborhood, perhaps at the store where they sell refrigerators, one that takes ice at the top and another that takes ice at the side. Compare these with Figure 22. Find out where the cold



FIG. 23. Find in this picture three places where something may happen to the milk to make it unsafe to drink. Even if the milk is pasteurized before the milkman delivers it, should it be allowed to stand long in the warm sun?

air from the ice can go down and where the warmer air is pushed up and around the ice.

Why do lemons, oranges and apples dry and wither when left many days in refrigerators in which the circulation is good? The answer is that the dew which you see on the ice at the top of the refrigerator is moisture from the air. The cold air that has passed around the ice contains relatively little moisture; but

as it becomes warmer, it takes up moisture from the air around the food. Then this warmer air rises and passes around the ice and some of its moisture is deposited on the ice in the form of dew. You see, then, if the circulation in a refrigerator is good, the air will be constantly taking moisture from the food and depositing it as dew on the ice. This is why fruit and other foods become drier if left for a time in a refrigerator.

A good way to find out whether a refrigerator has a good circulation of air is to place paper bags on several shelves and see whether they are damp or dry after a few days. If the bags remain dry, try putting some table salt in a saucer and leaving that in the coldest part of your refrigerator. Does the salt remain dry or do the salt grains take up water and stick together as they often do in a salt shaker during moist weather or rainy days in the summer time? If there is good circulation of air, the salt, as well as the paper bags, will remain dry.

Ice cream. "Ice cream" is rarely more than one-fifth cream; the rest is milk, eggs, sugar, gelatine and other foods. There are two reasons why milk mixed with cream is made into "ice cream." One reason is that the frozen sweet mixture is a very palatable food, and the other is that if kept frozen the ice cream may be preserved for many days because it will not "sour" or "spoil" as milk does.

In order to understand the freezing of ice cream, try these simple experiments: Put some salt on a

block of ice. Does the ice melt faster where the salt touches it? Why do we sprinkle salt on icy sidewalks in winter? Fill a glass or cup with crushed ice, and fill another with a mixture of one-fourth salt and three-fourths crushed ice. Then put one finger into the ice and another into the mixture of ice and salt. Which is colder? Is there much difference? Is the ice melting in both glasses? Watch for twenty to thirty minutes and see whether ice melts faster, with or without salt?

You have already learned that melting ice takes up or absorbs heat. Your finger in the melting ice feels cold because the ice takes heat from your finger. If the finger in one glass feels colder, it is because the ice in that glass is melting faster and taking more heat from your finger.

You have found that salt makes ice melt more rapidly and take up heat faster. This happens at any temperature down to -7°F . which is thirty-nine degrees colder than the temperature at which pure water freezes (32°F .). Below -7°F . salt does not melt ice, and therefore you could not freeze ice cream by melting ice on a day when the thermometer is 8° or 10° below zero (-8° to -10°F .). Of course, cream would freeze without melting ice on such a day.

Do you know how an ice-cream freezer works? The creamy mixture is put in a covered can which is surrounded by a mixture of one part salt and three parts ice. One part salt and eight parts ice will make smoother ice cream. The melting ice takes heat from

the freezer and from the cream. If there is ice and salt enough, this process will go on until the cream is frozen solid. In order to cool the cream rapidly and at the same time to break up big ice crystals, many freezers have machinery for stirring the cream as it is being cooled and frozen.

Artificial ice for preserving foods. If you put a drop of alcohol, ether or gasoline on the back of your hand, it evaporates quickly and your hand feels cold. This experiment shows that when a liquid evaporates, heat is taken away and we say that "cold is produced."

Alcohol and gasoline are liquids which will evaporate fast enough to cool your hand, but they do not evaporate rapidly at ordinary temperatures. Now, there are substances which evaporate or expand to a gas very rapidly even when the temperature is near freezing. These substances are used for making artificial ice and for preserving foods by cold storage.

Three substances now used for such purposes are ammonia, carbon dioxide, and sulphur dioxide. All of these are gases at ordinary temperatures, but may be compressed into liquids. Ammonia is used in big ice factories and the other two in ice machines attached to ordinary home refrigerators. Household ammonia is water in which the gas is dissolved. Open a bottle of it and smell the strong ammonia gas escaping from the water. It is this invisible gas which is used in ice-making machines.

In commercial cold storage rooms, fruits keep best at about 36° F. (3° or 4° above freezing of pure water),

meats at about 25° F., poultry at 0° to 10° F., and fish at zero (0° F.). These temperatures are kept rather steady in the cold storage rooms.

"Dry ice," which looks like snow, is now used for packing ice cream and for preserving foods. It is carbon dioxide compressed into a solid state. When it evaporates or changes back to gas, it absorbs heat and so cools any nearby food. It cools so rapidly that it is dangerous to touch it with bare hands.

Drying foods to preserve them. One of the oldest ways of making foods keep longer is by drying them. Some foods dry out as they ripen, and so may be kept for a long time without difficulty. Grains like wheat and barley have been taken from ancient storehouses, near the homes of the cliff dwellers in America, where they had been kept dry and unspoiled for hundreds of years. Look in the grocery stores and see how many dried foods are sold. What dried vegetable is commonly used in our homes? Eggs and milk are now dried in large quantities, especially for use by bakers.

Many people in various parts of the world cut meat into large pieces and then dry it; fish is also dried in the same way. Many uncivilized tribes know how to preserve meat and fish by drying. Meats are sometimes smoked with wood smoke to make them keep better. Ham and bacon are first soaked for some days in salt brine and then hung in a smokehouse, where hickory wood or sawdust or corn cobs are burned so slowly that there is much smoke and very little flame. The smoke from pine, spruce, and many other

woods will spoil the flavor of the bacon. Dried beef used to be smoked as well as dried. The kind now sold in the stores is not dried much, though it is still called "dried beef." Instead of drying, it is sometimes preserved in glass cans or jars, just as other kinds of food are canned by heating.

Salting or pickling foods. Strong solutions of salt and vinegar are often used. How are mackerel kept for sale in your grocery store? Are cucumber or "dill" pickles kept in barrels of salt brine by your grocer? Olives and many other pickled foods are heated after they are put into glass jars, to make sure that they will "keep," because the liquid which is around them has not enough salt and vinegar to kill the germs which might spoil the pickles if not heated.

Importance of preserving foods. One reason why these ways of preserving foods are very important is that they make some foods safer to eat. For example, when milk is evaporated and canned, germs that cause illness are killed by the drying and heating.

Another reason why food preservation is very important is that it prevents waste. Foods that grow only in season, such as strawberries, and which spoil very quickly, may be preserved so that they can be used months or even a year or more afterwards. We can now buy perishable fruits such as pineapples, oranges, and grapes in our city markets every week in the year because they are preserved by cold storage. Although hens lay most of their eggs in the spring months, by means of cold storage dealers can keep a

supply of fairly good eggs throughout the year. It is much easier to have a variety of foods for our tables now than it was formerly.

Food adulteration. We have in the United States a Pure Food and Drug Law, which forbids the shipping of adulterated food from one state to another. Many states have laws under which persons may be imprisoned or fined if they sell drugs or foods that

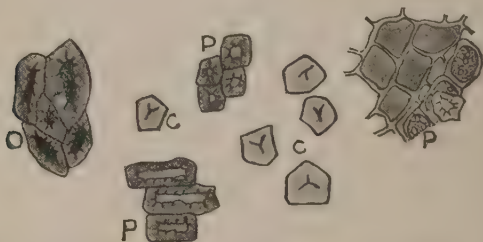


FIG. 24. The parts marked *P* are pieces of ground pepper. The parts marked *C* and *O* are corn starch and broken olive pits and were used to adulterate the pepper.

have been adulterated. Glucose may not be sold as maple sugar; used tea leaves may not be dried and sold again; starch may not be put into cocoa; chemicals may not be put into milk to keep it from souring; gelatine may not be put into cream to make it look richer than it really is; skim milk may not be sold as whole milk; and wood alcohol, which is very poisonous, may not be sold as medicine.

You may have heard complaints about the sale of adulterated food in your state. If there are such sales, it is probably because your state has not yet passed

the right kind of laws to protect you against adulterated foods. The United States law does not interfere with the sale of foods which are prepared, manufactured and sold within a state. It only protects one state from food adulterated in another state.

Improved ways of handling foods. We now not only have better ways of making foods keep until we want to use them but also better ways of handling them. More of our foods are now put up in sealed packages than formerly. This keeps them clean, and also makes it possible for us to know which firms are giving full measure and good quality. It is much easier to be sure that food is not adulterated with poor, cheap, or even harmful substances, if it is sold in a sealed package or can with the maker's name on it. Each firm is responsible for anything that bears its name; and no one can substitute cheaper or poorer material for that which is sold in a sealed container. Only a few years ago, it was quite a common sight to see jam in open tubs or small barrels in stores. Look around your grocery store and see if there is anything besides butter and cheese and vegetables which is still sold "loose," but which could be sold in sealed packages.

Care in selecting and preparing foods. Fresh fruits and vegetables are better than stale or old ones. As they grow older, vegetables become tougher and less easily digested; they lose their delicate flavors, so that we enjoy them less; and many of them lose part of their vitamins. Fresh young carrots at ten cents a

bunch may really be worth twice as much for food as old ones at five cents.

A second thing to remember is that much of the valuable part of fruits and vegetables is in and just underneath the skin or the rind. Why is brown bread better for us than white bread? Why do doctors sometimes say, "Eat the skin, too, when you eat your apple a day"? Why did the Japanese soldiers improve in health when they were given whole rice instead of rice which had the outer surface polished off to make it look nice and white?

How to prevent constipation by selection of foods. Another reason for eating some whole-wheat bread instead of white bread only, and some coarse vegetables like cabbage, string beans, and turnips, is that the intestines need a certain amount of coarse material to keep them active. Constipation is more common among persons who do not eat a variety of fruits and vegetables. If attention to the food and to regular outdoor exercise does not cure constipation, a doctor should be consulted, because the longer it lasts the harder it is to cure.

How food is used in the human body. So far in these lessons on our food supply it has not been necessary to know how we use food in our bodies. Children learn from the conversation of older people that everybody has a stomach and intestines and liver; and that when we eat food it goes to the stomach and intestines and is "digested." Many children learn from experience that if they eat too much food or the wrong

kind, such as unripe apples, they will have what they are told is a "stomach ache." Even little children hear the doctor tell their mother that the trouble is "indigestion." Then mother says that the doctor means that the food has not been properly "digested" by the stomach, and the pain comes to warn that something is wrong inside and needs the doctor's help. Just what the word "digestion" means children do not know before they have had lessons on how we use our food, but they feel sure that since "indigestion" hurts so much, "digestion" must be very important.

Did you know such facts about your own body before you ever went to school or looked in a book on health? Did you learn just enough to make you want to learn more about how we use food in the body? Most children say "yes" to this last question, and therefore this lesson will give the most interesting facts that doctors and physiologists have discovered concerning the parts of our bodies which use food and how they use it.

You know already that food taken into the mouth goes into the throat or pharynx and then is swallowed by a long tube called "gullet" or "esophagus" and enters the stomach. You know that after a big meal the stomach feels "full," and then you do not care to eat any more for some time.

What makes horses and cows stop eating? Did you ever see them stop when there was plenty of food left? Do they ever eat too much? Ask a farmer what

causes the kind of indigestion called "colic" in horses and "bloating" in cows.

You know that after eating a meal the stomach feels "full," but that after a few hours it feels "empty" and you are hungry again. This is because the food taken into the stomach has been softened and mixed with water so that it can pass through a narrow passageway into the intestine where a large part of digestion takes place.

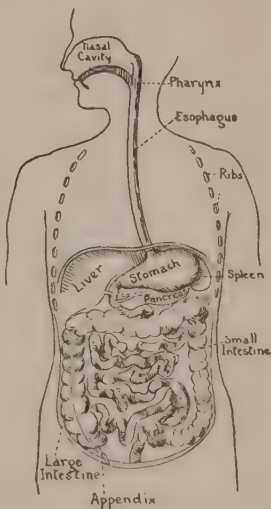
The digestive organs. The parts of your body that receive and digest food are known as the "organs of digestion." In physiology an "organ" is a part of the body that does a special kind of work, for example, the *stomach* digests food, the *eye* sees, the *muscles* move, the *teeth* bite, the *heart* pumps blood — these are some of the many organs of the body. What other organs of your body can you name?

The "organs of digestion" include (1) the alimentary canal or alimentary tube, through which food passes, and (2) the glands, such as the liver, which form or secrete liquids that aid in digesting food. The word "alimentary" means "supplying nourishment."

The alimentary canal consists of a long tube that extends through the body. The parts of this tube are mouth cavity, pharynx, esophagus, stomach, small intestine, and large intestine. Food goes through these in the order named. Study Figure 25 and find each of these parts. You can open your mouth and see your mouth cavity with a mirror and look down into your throat or pharynx. You cannot see

down into the esophagus, but the doctor can slip a soft rubber tube down it when he finds it necessary to "pump" poison or undigested food out of a patient's stomach. If you have ever had a "pain in your stomach," you know that this organ is located

FIG. 25. This diagram shows the position of the organs of digestion, but does not show their exact shape or size. Find pharynx, esophagus, stomach, small intestine, large intestine, appendix, pancreas, and liver. The lungs and heart are not shown but they lie just above the stomach and liver.



below the chest on the left side of the body. The intestines are really a coiled tube many feet long, which is packed into the lower part of the body, called the abdomen.

The glands which form or secrete fluids used in digestion are the salivary, which pour saliva into the mouth cavity; the gastric, which make gastric juice in the stomach; the intestinal, which lie in the walls of

the intestines; the liver, which lies near the stomach and pours its fluid, called "bile," into the intestines; and the pancreas, which lies between the stomach and small intestine, and pours its fluid, the pancreatic juice, into this intestine. Find the position of the liver and pancreas in Figure 25. The spleen shown in that figure is not part of the digestive system, but is chiefly useful because it makes white blood corpuscles, whose use you will learn later.

Chewing and swallowing. When liquid food, like milk and soup, is taken into the mouth, it is at once swallowed, just as water is. There is no chewing movement of the jaws. Did you ever see a baby or a young animal attempt to chew when drinking milk?

When solid food, like bread or meat, is taken into the mouth, we begin to chew or grind it between the teeth. The purpose of this is to grind the food into bits and mix it with saliva. The saliva contains a substance which can change starch to sugar, and if we chew bread or some other starchy food a long time, some of the starch in it will be changed to sugar and the food so chewed will taste sweet. If, however, we swallow starchy food quickly, without much chewing, very little of it will be changed or digested to sugar. This is one reason why starchy foods should not be washed down with water or milk before they are thoroughly mixed with saliva.

Saliva at once dissolves some sugar, which, in turn, instantly affects the nerves of taste. That is why we taste candy so quickly.

Only sugar and starchy foods are affected by the saliva. Some sugar is dissolved in saliva and some starchy food is changed to sugar. Most of the starchy food is digested in the intestine. Fats, proteins, and minerals are digested in the stomach and intestines.

Food does not drop down the esophagus into the stomach, as many people suppose. It is really forced down by contractions of the muscular walls of the esophagus. Can horses and cows drink when their



FIG. 26. When food enters the stomach, its walls contract, squeeze the food, and slowly force it from the stomach into the small intestines. These black pictures show that the amount of food in a cat's stomach becomes less as the food is squeezed into the intestines. (*After Cannon*)

heads are lower than their stomachs? Did you ever see a circus clown drink a glass of water while standing on his head? Evidently, by swallowing, animals and persons can force even liquid food to go "uphill."

Movements of the stomach and intestines. Foods are moved along through the stomach and intestines because these organs are constantly contracting and squeezing the food, so that it is mixed very thoroughly

with the juices from the stomach, the intestines, and from two big glands, the liver and the pancreas. If you examine Figure 26, you will get an idea of how much your stomach contracts. The black shadow pictures show the amount of the food in a cat's stomach as the walls contract and force the food towards the intestines. Of course, the original pictures made by the use of the X-ray were the same size as the mass of food itself, but they have been reduced for printing in this book. The cat's food was mixed with a harmless substance which made it possible to photograph



FIG. 27. These black pictures, from X-ray photographs, show the changes that take place in any part of the small intestine of a cat as the food is digested and moved along. (*After Cannon*)

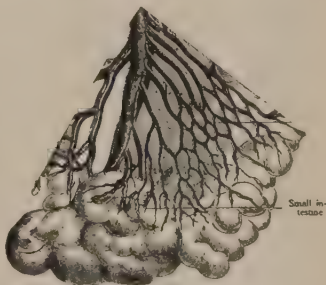
the food with the X-rays. By a similar method movements of the human stomach and intestines are watched or photographed by doctors.

Digestion in the stomach. When food reaches the stomach it is soon mixed with gastric juice. This digests some protein and some mineral foods and softens fat meat, such as bacon. The movements of the stomach break up the solid pieces of food into very fine particles which can be squeezed through the narrow passageway from the stomach into the intestine. As soon as the food in the stomach is emptied into the intestine, we begin to feel hungry. The reason why we feel hungry so soon after we have a meal

of liquid food, such as milk, cocoa or soup, is that they pass quickly through the stomach into the small intestine. Hard-working men, such as farmers and lumbermen, often say they prefer food that "stays." They mean solid food that stays a long time in the stomach so that they do not feel hungry long before the next meal is ready.

Digestion in the intestines. When food passes from the stomach into the small intestine it is in such fine

FIG. 28. The picture shows a small part of the small intestines and the blood vessels connected with them. These blood vessels absorb digested food contained in the intestines. (*After Morris*)



particles and so mixed with water that it looks like thick soup. This soupy mixture is then mixed with the fluids or secretions from the pancreas, liver, and glands in the wall of the intestine. These secretions finish the digestion of the foods which were first acted on by the saliva and next by the gastric juice. The effect of each of these secretions is described in text-books of physiology used in high schools and colleges. All we need to learn now is that all kinds of foods may be digested in the intestines.

You will now understand that digestion means

breaking foods into fine particles and then changing them so that they will dissolve in water, just as sugar dissolves in water. The reason why food is digested is that it must be prepared to soak through the lining of the stomach and intestines into the small blood-vessels which carry the digested food to the larger



FIG. 29. This picture shows some of the large blood vessels (veins) of the leg. In every organ of the body there are numerous networks of blood vessels which distribute blood to every part of it.

blood-vessels and heart and from there to all parts of the body. The process of soaking up digested food in the small blood-vessels is called "absorption." Even liquid foods, such as milk and soups, must be digested.

By the time the food has been forced along to the end of the small intestine, nearly all of the material in it which the body can use has been digested and absorbed by the blood. The undigested part of the food finally collects in the large intestine, where it may interfere with health, unless regular bowel action removes it daily. Constipation is the clogging of the large intestine by undigested food. It may be caused by the wrong kind of food, by eating more than the

body needs, by taking cold, or becoming nervous and overtired. In the first book in this series, *Health for Every Day*, you were told how to avoid constipation by eating vegetable foods, fruits, drinking six to eight glasses of water each day, and taking all the



FIG. 30. After the shell of the egg was broken to show the inner thin skin, as in the left-hand picture, it was covered with water. Look at the right-hand picture to see whether water can pass in through the thin inner skin. This experiment shows how water and digested foods are absorbed through the thin walls of blood vessels.

exercise you can. If you "catch a cold," take a laxative medicine to prevent constipation.

Overeating is likely to lead to indigestion and constipation, and both of these if continued long will interfere seriously with health. Stop eating just before you feel you have enough. Your stomach can be stretched by forcing a large amount of food down your esophagus, but remember that you are not a python which can swallow and digest animals that stretch its stomach enormously. Therefore, do not try to "break records" by eating eggs at Easter time or doing any other "stunts" in eating or drinking.

Especially, do not allow or encourage little children to eat too much and in this way stretch their stomachs to an unnatural size. Farmers want their heifer calves to eat large quantities of grass and hay so that when they grow old enough to give milk, they can eat a large amount of feed and turn it into milk. Human stomachs are not built like those of grass-eating animals and should not be stretched by overeating. This applies especially to children. Considering the possible effect on health in adult life, it is not kindness to set before children so much food that they "stuff" their stomachs until they are stretched to full capacity.

You now understand some of the more important facts concerning how food is digested, absorbed by the blood, and distributed to the living tissues in all parts of the human body. Turn over the pages of this chapter and learn where we get the kinds of foods which have been mentioned in this lesson on digestion.

Alcohol is not a food. Alcohol, either in the pure state or in the form of alcoholic drinks, like beer, whisky, and wine, is not a food in the sense that sugar, starch, fat and protein are foods. It is true that in very small quantities it may be used by physicians when a patient is too weak to digest enough of the regular kinds of food, but when used in this way it is really a medicine and not a food. It could not support life for a long period because it cannot take the place of protein foods, which as you know are necessary for the growth and repair of the human body.

Many doctors think that the very slight nourishing effect of alcohol is of no value, and therefore they never prescribe it for their patients. Some of them are sure that alcohol is without food value, and that it oftentimes does a great deal of harm to sick people.

Even if it were agreed that alcohol might have a very slight value in taking the place of some food for people who are ill, it would not be useful as a food for well people. It would not be wise to recommend it as a regular part of the daily diet of healthy people.

It is the opinion of many experts on drugs that even in moderate quantities alcoholic drinks tend to interfere with the work of the brain. When alcohol is regularly used during the day's work it diminishes the amount and quality of work done. Typesetters, typists, and other people who do kinds of work which it is easy to measure both in speed and accuracy do not do so well after they have had a lunch which contains alcoholic drinks. They do less work and they make more mistakes. Generals who command armies and contractors who employ large groups of men agree that alcoholic liquors taken during the working hours decrease the amount and the quality of the work done. Therefore, alcoholic liquors are unlike foods which supply the energy for work.

It is clear that those persons who are anxious to do their best work, either with their brains or with their hands, should avoid regular use of beverages, such as beer and wine, in which there is enough alcohol

to have a definite effect on the heart and nervous system. There is no doubt that liquors containing 5 to 10 per cent of alcohol, such as the beers and wines that were formerly sold in the licensed saloons of this country, do have a marked influence on the work of the human body. All of the experiments on which the conclusions given in the existing scientific books are based, were made with the alcoholic drinks which were found in this country before the prohibition law was passed. We do not yet know what would be the effect of drinks which contain a very much smaller amount of alcohol, for example, one-half of one per cent. That should be tested by the experts in physiology who already know the effect of stronger alcoholic drinks and would know how to test scientifically the effects of the weaker ones.

QUESTIONS FOR THOUGHT AND SUGGESTIONS FOR STUDY

1. Think of some unselfish things which you could do to help others to keep well. Make a list.
2. See whether you can fill in the following outline without looking at your book. If necessary, re-read the part of Chapter I which will help you to make the outline.

Health in Home and Neighborhood

- I. Foods a.
 b.
- II. Heating and Ventilating a.
 b.

(Finish the outline. Be sure you have eight topics.)

3. Finish this balanced outline.

Plenty of Good Wholesome

Food

People are likely to be

1.

2.

Shortage of Food

People are

.....

because

4. Would a coal strike affect the food supply of a large city?
Give reasons for your answer.

5. China does not have good roads. What has this to do
with famine?

6. Three main causes of famine are.....

7. Chapter I is about Food Supply. Can you list the six
topics discussed under *Foods* in the chapter?

8. Finish the second column mentally.

1564

Today

Indians

.....

corn

.....

storehouse

.....

9. Many foods come from *farms*. See how many you can
name in exactly one minute.

10. Take a sheet of paper and divide it into three columns.
Head your columns as follows and make lists under each heading:

*Plant Foods**Animal Foods**Mineral Foods*

11. How can grass be turned into milk?

12. How can corn be turned into meat?

13. How can wheat be turned into eggs?

14. How can hay be turned into cheese?

15. Make a picture or cartoon to show what a good hen or
a good milch cow is worth.

16. This is a trick question. Look at the maps and tell,
if you can, which states raise the greatest number of pigs.

17. Make a cartoon to show that indirectly or directly all
animals feed on plants.

18. Give one or two examples of each of the following "classes of foods," — sugars, starches, proteins, fats, minerals.

19. Just how does a vitamin test differ from a test for sugars, starches or fats?

20. How can fat be turned into heat?

21. How can sunlight be turned into energy?

22. How can our worn-out cells be replaced?

23. Make a cartoon to show who should have more food, a mail-carrier or a motorman or a conductor.

24. Make a similar cartoon comparing a football player with a bookkeeper.

25. Give four reasons for cooking food.

26. Make a set of drawings to show different ways of cooking foods.

27. Make a set of pictures to show ways of preserving foods.

28. Make a poster to show how foods *should* or *should not* be handled.

29. Make a poster to show how foods should be selected.

30. If you are interested in learning to locate your bones, play one of these games:

1. Some one says the name of a bone, and calls the name of a person playing the game. That person must touch part of his body to show where the bone is. If he does not know, or makes a mistake, he is out of the game until he looks up the answer in his book. If he shows where the bone is, he gets the next turn.

2. You point to a bone in your body, and call some one's name. He answers by naming the bone. You then continue as in game 1.

CHAPTER II

OUR WATER SUPPLY AND HEALTH

Water and health. One of the most important things that affect our health in home and school and neighborhood is our water supply. If there is an abundance of pure water for drinking, for preparing our food, and for keeping our bodies, clothes, homes, and streets clean, there is sure to be better health for everybody who lives in our neighborhood. If we do not have pure water, we may get diseases such as typhoid. If we do not have water for keeping clean, we may have unhealthy skins and may pass disease germs from our dirty hands into our mouths. And what is more important still, if we have dirty bodies we soon lose our self-respect and become like ragged "hobos" or "tramps."

If we want to be healthy and self-respecting we must have water and plenty of it in our homes and schools and in all other places where people live or work in our neighborhood. These are some of the reasons why water is so important for health; and because these reasons affect every one, this entire chapter is devoted to the water supply for home and neighborhood.

Water necessary for living things. We have learned in previous lessons on health that water is necessary

for all living things, that is for animals, plants, and humans. All these need water in order to live and grow.

There are some microscopic animals and plants which can live a long time in a "sleeping" or dormant condition without taking water or food, and in fact some of them do live in this way when their bodies seem to be or are very dry. Many of these animals and plants living in pools are left very dry when the water evaporates in the summer time. If we collect some dry soil, rotten leaves, etc., from the bed of a dried-up pool when it is dry and dusty, and place these materials in a jar with water that has been boiled and cooled, a number of different kinds of small live animals and plants will soon appear in the jar. Where did they come from? Could they come from the boiled water? If the jar has been kept covered, we feel sure that they did not fall in from the air. Evidently the animals and plants that appear in the jar came from the dry dirt and leaves that we collected from the bed of the dried-up pool. When you study biology in high school you will learn about some of the small living things that are not killed by drying because they can stop growth and all other activities and remain "asleep" or dormant in a dry condition for a long time.

It is interesting to note that these small animals and plants which are not killed by drying are just like ordinary animals and plants in that they also require water when they are actively living and growing and forming new individuals of their own kind.

Another illustration of the fact that water is necessary for active life is that all seeds have in them small living plantlets which remain dormant a long time if the seeds are kept dry. Everybody who has had even kindergarten lessons in nature study knows that seeds must have water in order to sprout, or, as we say, germinate, and grow into plants. These plants take food materials from the air and soil. They also take oxygen from the air. Finally they grow to full size, flower, and produce new seeds in which life is dormant as long as enough water is not available for germination and growth.

Chemists have shown that even though seeds look very dry there is always a small amount of water in them. If they get too dry they will not germinate even when moistened, because the plantlets in the seeds are killed by excessive dryness.

Of course, as you have learned in your nature-study lessons, seeds do not germinate unless the temperature is right. This means that even though they have water, seeds cannot germinate until they have heat, but the amount of heat required depends upon the kind of seed. Every boy on a farm knows that seeds of oats and peas will germinate when planted very early in the spring, as soon as the frost is out of the ground, but that corn and beans will not germinate if planted when the ground is cold.

The important point to be remembered is that the seeds of flowering plants and the spores, which are the minute "seeds" of molds, ferns, mosses, and other

flowerless plants, require water and a certain amount of heat in order to germinate and grow into plants. This is also true of many larger plants which are not killed by ordinary drying and are able to start growth as soon as they get sufficient water and heat.

A large part of the bodies of animals, plants, and humans is made up of water. If we dry thoroughly a dead animal, such as a frog or a fish, the weight after drying is not more than one-third of the live weight. Does this not show that the body of a live fish or frog is about two-thirds water? It is estimated that the body of a boy or girl weighing one hundred pounds has nearly seventy pounds of water, that is, seven-tenths or seventy per cent water. Dogs and common farm animals have about the same amount of water in the tissues of their bodies. Lean meat is about one-half water, that is, five-tenths or fifty per cent water.

Plants also have a large amount of water in their tissues, usually more than animals have. Apples and potatoes at the time of harvesting are nearly eight-tenths or eighty per cent water, and fresh tomatoes are nine-tenths or ninety per cent water. Every boy on a farm knows that grass is very heavy when the mowing machine has just cut it, but that after drying for a day or two in the hot sun and wind, it becomes hay, which is very much lighter than green grass. Another example is that of "green" stove wood, which is cut from live trees. You know a stick of it is very much heavier than one of equal size that has been drying in the woodshed for several months.

If you have scales which indicate pounds and ounces accurately, weigh a stick of "green" wood, record the weight and, after drying it for several weeks near a stove or radiator, weigh it again. How much water has been lost? Another experiment: If a small bundle of green grass is weighed, then dried in the sunshine and weighed again, it will lose a larger part of its first weight than the stick of wood did. The reason for this is that in a given weight of grass, say four pounds, there is more water than in four pounds of green wood.

It is not so convenient to try this same kind of experiment with an animal, but if you can, weigh a fresh fish and then dry it very rapidly so that it will not decay. Then weigh it again. How can you find the amount of water lost by drying? The dried fish sold in markets are not so dry as they could be made in a drying oven. They contain some salt which, of course, adds to their weight.

What kinds of dried fish or dried meats, dried vegetables, and dried fruits, are sold in the markets in your neighborhood? All of such dried foods come from either animals or plants.

The reason why dried foods, such as fish and fruits, are not spoiled or decayed by the action of bacteria is given in the chapter on foods in this book.

What happens to a house plant if you forget to give it enough water regularly? What happens to growing corn and other growing crops if there is a long period of dry weather? Why are many farms in certain parts of the United States irrigated? Most of these farms are

in the eleven states farther west than Kansas. There are over 50,000,000 acres of land in the United States which if irrigated would grow crops, but less than half of this area is now supplied with water for that purpose. Look in your books of geography and locate these states.

Why do wild animals go a long distance to water holes? Why do men and animals perish when they get lost in deserts?

We learn from this lesson that water is necessary for all living things because it forms a large part of their bodies, and in order to keep healthy they must have at all times all the water they need.

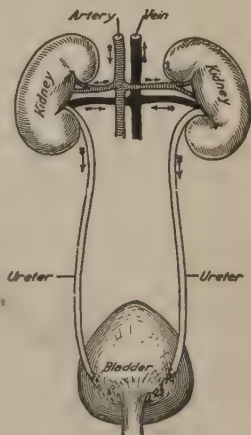
How the human body uses water. In the lessons on food we have learned that water is necessary for dissolving or making liquid the solid food that we digest in our stomachs and intestines. Most of the dissolved or digested food is absorbed or soaked up by the small vessels or tubes which are in the walls of the intestines (see Figure 28). These small tubes connect with the larger blood vessels, and so all digested foods, that is, foods dissolved in water, pass into the circulating blood as soon as they are absorbed from the stomach and intestines.

You have already learned that our blood consists of a liquid, called plasma, in which float millions of microscopic cells, called red and white corpuscles. The plasma is largely water containing dissolved food which is to be distributed to the living tissues needing food. The plasma with the aid of the blood corpuscles is also busy carrying oxygen from the lungs to all parts

of the body, and carbon dioxide back to the lungs where it passes into the air we breathe out of our lungs.

The water in the blood performs still another important kind of work. It takes up or absorbs from all parts of the body waste substances which must be removed from the blood by the kidneys. Thus, as the blood circulates through either of the kidneys,

FIG. 31. The kidneys take from the blood excess water which contains waste substances that must be removed from the body. The upper arrows show the path of the blood from the arteries to the kidneys, then out by the veins and back to the heart. The ureters are tubes leading from inside the kidneys to the bladder.



water that is no longer needed in the body “oozes” (a biologist would say “osmoses”) from the blood into hundreds of little tubules that are in each kidney. These tubules connect with the ureter, a tube about one-eighth of an inch across (or in diameter), which leads from each kidney to the bladder. Is it not clear that water oozing or osmosing from the blood into the kidney tubules would pass through them into the ureters and then through these tubes into the bladder? But

remember that the water that enters the tubules is not merely water. It has dissolved in it substances that are no longer needed in the body. Examples of these are excess salt or sugar, certain medicines, many useless or even harmful substances in our foods, and waste substances formed when foods are used to build living tissues in all parts of the body. All these kinds of substances are found dissolved in the water that the kidneys take out of the blood. The most abundant of these substances are salt and *urea* (so named because it is found in urine). Urine is a scientific name which has come down to us from the ancient Greeks, who applied it to the water that accumulates in the bladder. Of course, the old Greeks did not know, as you do now, that the water accumulated in the bladder came from the blood in the kidneys and that it contains salt, urea, and other waste substances that would harm the living tissues if left in the blood. They did not know these interesting and important scientific facts because the physiology and chemistry of the body were not well known even two hundred years ago.

One excellent reason therefore for drinking six to eight glasses of water a day is to make sure that the blood will have plenty of extra water which the kidneys can use for dissolving or flushing out the salt, urea, and other waste substances which must be removed from the blood if the body is to be kept healthy.

Doctors have learned during the past fifty years that by examining urine with the compound microscope, and by chemical tests, they can discover much

concerning the health of their patients. Hence when people are ill, physicians or chemists often make a urine analysis in the laboratory to find out whether they have certain diseases. Such examinations are also made for well people in order to find out whether there is any weakness that may lead to a diseased condition. No one can get a life insurance policy now without having a urine test made by a doctor, who must make sure that the man or woman examined has no kidney or other disease likely to shorten his or her life. No doubt you have heard older people speak of Bright's disease, diabetes, and tuberculosis of the kidneys. These are three diseases that are often discovered or diagnosed by means of an examination of urine when there is no other way of finding any sign of disease in the people examined.

The bladder is merely a strong muscular bag for storing urine for several hours at a time. Except in very young children, the emptying of the bladder is under the control of the will. Physiologists say that an act so controlled is voluntary. Removal of urine is necessary for life and good health and therefore not shameful, as many persons who have not studied physiology think. The proper, dignified, and scientific name for this process is urination, a word which all educated people should know.

Why do humans need water? The first answer to this question is that we need water for the growth and health of our bodies just as all other living things do. This is so because, as we have learned,

about seven-tenths or seventy per cent of the materials composing our bodies is water.

A second answer is that we need water in preparing many kinds of food. Vegetables and fruits must be washed in clean water, and we must have water for boiling or preparing many food mixtures (soups, stews, etc.).

A third answer to the question is that we need water in order to keep our bodies, our clothing, our homes, our public buildings, our useful animals, our stores, factories, and our streets clean.

There is another and fourth reason why civilized people need water, namely, that it has many practical uses. It is necessary for making steam which we use to generate power, light and heat. It is needed for putting out big fires, and large quantities of water are used in the manufacturing of numerous things which we use in our daily life.

The amount of water needed for the second, third, and fourth purposes is very much greater than that needed for drink. For example, New York City supplies on an average over 100 gallons of water per day for each of its inhabitants. As you have already learned, each person should drink four to eight glasses per day. This is less than a half gallon. (How many quarts? pints?) So far as water for drinking is concerned it would not be necessary to supply as much as one gallon a day per person.

Of course a large part of the water supplied in big cities like New York and Chicago is used for washing streets and flushing sewers, in manufacturing,

and in generating steam for heat, light, and power. Nevertheless, each person needs for his own use in a city home which has a bathroom, at least a barrel, or fifty to sixty gallons of water each day. Even a small four-foot bathtub requires about half a barrel of water for each person's bath, the wash bowl requires one or two gallons every time the hands and face are washed, and the toilet bowl uses three to four gallons every time it is flushed. If you add these amounts of water together you will see that nearly a barrel of water will be needed daily for each person.

Of course, a great many families in cities and towns are not so fortunate as to live in modern houses with bathrooms, but nearly all new houses in towns and cities have such rooms, and the farmers and inhabitants of villages of the United States are buying and installing tens of thousands of bathroom outfits every year. If you live in a farm or village home which has not a bathroom, look in a catalogue of plumbing supplies, or ask a plumber, to find out how much a simple bathroom outfit would cost. On later pages of this chapter you will learn how water is supplied to the bathroom, and in another chapter you will learn how the waste pipes are connected to a sewage system. Many farmers and their sons are "handy with tools" and can easily learn from the printed directions published by firms that sell bathroom fixtures how to install a bathroom outfit with water and sewage connections. This work can be done by any one with a little mechanical ability who lives in a village or the

country, but in many cities the sanitary law and the rules of labor unions permit only licensed plumbers to do such work.

Animals need water for keeping clean. Many kinds of animals live all of the time or a large part of it in water and so their skins are always clean. Did you ever see a dirty live fish in the water? If you go to a zoölogical garden, notice that the fur of seals, polar bears, and other animals which spend much of their time in the water, is clean. Did you ever see a bird take a bath? If so, how did he wash himself? A traveler has recently reported that on islands west of South America, where there are enormous flocks of sea birds, the birds often get very filthy when walking around on the islands, but from time to time they fly out over the ocean and wash their feathers by plunging into the water. Did you ever notice that horses, cows, pigs and dogs on a farm like to stay out in the warm rain? The falling water is probably as pleasant to them as a shower bath is to us. Several years ago a farmer in Ohio wrote that he had a big horse which, after working all day, in warm weather, would go to a river near the pasture, lie down in the water and take a bath all over. Of course, when controlled by man, animals often do not have a chance to keep clean. For example, in driving through the farm districts of many states, one often sees horses and cows that are disgustingly filthy because they are owned by slovenly farmers who keep them in dirty barns. Do you prefer milk from such cows?

How we get water for use. Water is so important that, as far back as history goes, human beings have always planned to have a good supply. Many wild animals go a long distance for water for drinking and then go home to their feeding grounds, but primitive people seem to have preferred to live in caves, rude tents, or huts, near springs, lakes or streams where good water was abundant. Some uncivilized tribes now living in remote regions, such as the interior of South America and Africa, are said to live in this simple way.

When primitive men went hunting they could wander far away from their water sources because they could carry a supply of water in simple containers, such as earthen jugs, gourds, and water bags made of the skins of animals. Carrying water in skin bags is still common in the desert regions of northern Africa and elsewhere. Of course, wild animals do not carry water, and some do not require water every day. You have read in your books of geography that camels are better than horses for crossing deserts. This is so because the camels have peculiar stomachs that hold water enough to last them for twelve to fifteen days. Sheep also can go a long time without drinking water. In the grazing lands of the Western States there are many pastures where sheep do well all summer with only the dew on the grass as their supply of water. Cattle and horses could not live in such places, and water is hauled in tanks and barrels for the use of the men and dogs in charge of the sheep.

The earliest people first drank out of springs and brooks, just as animals do and just as boys even now like to do when they go "hiking" in wild places. Perhaps primitive men soon learned to hold the palms of their hands together and to scoop up water for drinking. (Can you hold water in your hands this way?) This was the first drinking cup and it was the beginning of improvement over the animal way of drinking water. The next improvement was the use of sea shells, clamshells, gourds or calabashes, or any other natural objects which would hold water. The next steps were the making of earthenware vessels, the sewing together of animal skins to make water bags and the digging of large cavities in logs.

All these primitive methods of getting and storing water are still used in some parts of the world. In the states east of the Mississippi there are still a few old "water troughs," often called "dugouts," made by chopping a big cavity in one side of a log. They were used to hold water for horses and cows, feed for pigs, and rain water caught from the eaves of houses. Even less than fifty years ago in Ohio, Indiana, and other states many little "dugouts" holding only a few gallons of water were used in the log cabins of early settlers, and hundreds of these crude vessels were used for catching the sap from maple trees. No doubt you have read that similar "dugouts" were used as boats by the American Indians. You can see some of these Indian "dugouts" if you ever visit the Museum of Natural History in New York City.

Of course, buckets were in use long before these states were settled by people who came from the Eastern States, but the pioneers in Ohio and states beyond did not have enough buckets. It took a good cooper more than a day to make a good bucket, but a man with a sharp axe could in a short time make a "dugout" which would hold drinking water, maple sap, or serve as a washtub. If you are ever camping in the woods and need an extra washbasin, take your hatchet and try chopping a small "dugout" about two

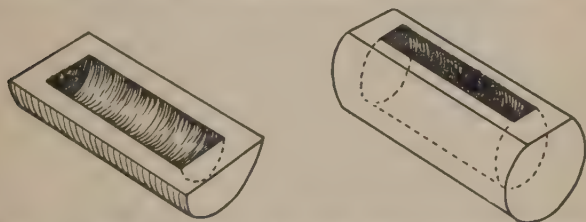


FIG. 32. The left picture shows a trough chopped from half a log; the right one has a deeper cavity, indicated by the dotted lines, and is a "dugout" made from an entire log.

feet long from half of a small log as shown in Figure 32. Of course you should not cut down a living tree, as you can always find plenty of fallen trees which are better for this purpose than green trees.

Bottle gourds are easily grown in many parts of the world. You can purchase seeds from dealers if you want to grow some gourds in order to see how to make dippers and bottles by digging out the soft central portion or pulp, just as we make Jack-o'-lanterns for Halloween by digging out the center or pulp of a

pumpkin. Fifty years ago gourd dippers were very common in many parts of the United States east of the Mississippi, but they could not be cleaned properly and have since passed out of use because people could get tin dippers at a reasonable price.

Travelers tell us that gourd dippers are still used in many parts of the world where the people have no glass or metal drinking vessels, and in some other places where the people have not yet learned that such dippers might pass disease germs, such as tuberculosis, from a sick to a healthy person. This possibility is so great that gourd dippers should not be used except as curiosities to show how primitive people made their drinking vessels. In another chapter we shall learn that even tin dippers used by a number of persons might transmit tuberculosis germs, even if the dippers are washed once every day in boiling water with soap. Of course that is the reason that in many parts of the United States the laws prohibit the public drinking cups and dippers which we used to see chained to pumps and drinking fountains.

Why people began to dig wells. We have seen how people first got water from springs and streams near their primitive homes. There came a time when in order to get more food many people had to migrate and build their homes far away from natural water sources, such as springs, lakes, and brooks, and then man had to dig deep holes called wells. Even in many dry lands, such as deserts, there are spots of moist soil which show where water might be found by digging.

This underground water has been stored in layers of sand or gravel, or in soft rock, since the last rains, or it has run a long distance under ground from some higher land, such as mountains, as you will see in Figure 33.

The old wells in many countries show that people first dug wells in spots where there was some indication of water. When it became necessary to dig them in other places, the diggers were anxious to find some



FIG. 33. This picture shows a valley with two wells into which water comes from the second layer, which is composed of gravel or soft rock. This water-bearing layer gets its water from higher ground shown at both ends of this picture. Water from rain or melting snow soaks into this higher ground and runs down into the lower places, where the wells are dug.

way of making sure that water would be found at certain spots. This led to a queer method which some people still believe in and which consisted in holding in the hands a forked stick which was supposed to turn when the man who carried it passed over a place where water could be found. It was said that these forked sticks should be cut from peach trees, witch hazel, and sometimes willow trees. Scientific men have often tested this method of finding water with a "water witch" and have reported that it has nothing to do with finding water. Of course

it often succeeds because there are so many places in which water can be found if a hole is dug down about twenty to fifty feet. Like many old superstitions which have come down to us from the past, the belief in the use of "water witches" is interesting, even though we no longer accept it. If a man is thinking of digging a well in the country where other wells have not been dug and so does not know how the layers of soil are arranged, it would be wise to consult a geologist who has made a study of the arrangement of the underground layers of the earth with reference to whether they contain water or not. In many states such an expert is connected with the department of geology in the agricultural college.

The first wells were merely temporary holes a few feet deep. Such shallow wells are still made by the uncivilized natives in many parts of the world today. In order to keep these wells open permanently some kind of lining or curb of wood, stone, or brick was necessary, especially when men learned by experience that water could often be found at great depths. There are still in Egypt very deep wells which were in use when the pyramids were built. At Cairo there is an ancient well cut in solid rock to a depth of about 300 feet, and the Chinese long ago dug wells to depths of fifteen hundred feet. In the yard of the old castle that has stood for more than a thousand years on the hill in Nuremberg, Germany, there is a well five or six feet across and 340 feet deep. It is supposed to have been dug so that in case of siege

by an enemy the inhabitants of the castle would not run short of water. This hill is composed of sandstone rock and so a curb or wall was not necessary.

Nowadays very deep wells are not dug with pick and shovel because a modern machine can drill a hole two or more inches in diameter and line it with a metal

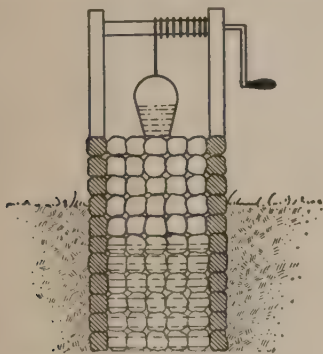


FIG. 34. An old-fashioned windlass for lifting water from wells, many of which are still used. Dust and insects fall into such wells.

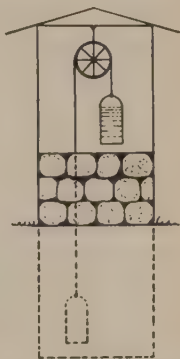


FIG. 35. A well-pulley for raising water. Like the well-sweep (Figure 36), this lets in dirt from the air as well as from the dirty hands which often pull the rope.

pipe. Many such wells are hundreds of feet deep and supply an abundance of pure, cool water. In the water-works at Galveston, Texas, there are thirty wells with seven-inch pipes sunk to a depth of 800 feet. In Paris there is a well three and a half feet across and 2536 feet deep. In different parts of the United States there are hundreds of wells which are more than 1000 feet deep.

When uncivilized men dug the first wells, they had to have some way of getting the water to the surface. Probably the simplest way was dipping the water by means of a vessel, such as a crude bucket, let down by a cord held in the hands. Then the windlass and well-pulley, as shown in Figures 34 and 35, were invented for lifting the bucket. "The Old Oaken Bucket" in the poem by Samuel Woodworth, was lifted by a well-sweep (see Figure 36). Many of these can still be seen

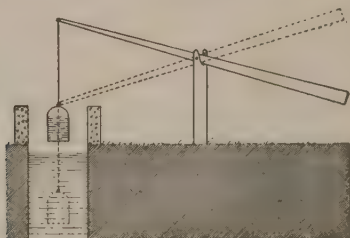


FIG. 36. A well-sweep for lifting an "old oaken bucket." As in the case of the wells in Figures 34 and 35, dust and insects can fall into the water in this well. Then, too, dirty hands may handle the rope that is let down into the water.

in New England. The chief objection to all these methods is that they allow dirt to get into the well, especially if dirty hands pull the rope; and also they are slow in raising water as compared with modern pumps.

An improvement on the windlass, which raised only one bucket, is the endless chain with buckets every foot or two so that they dip into the water and carry it up as long as some one turns a crank.

In the deep (300 feet) well at Cairo, Egypt, water was raised by means of buckets on endless chains. The endless chain for the lower half of this well raised the water halfway. The power to operate the chains was furnished by a team of mules which worked in a room about one hundred and fifty feet below the surface. The mules were led down to this room through a spiral pathway. Then from the first level to the top of the well another endless chain, operated in the same way, lifted the water to the surface. This well was in use until very recent times, but unless it is desired to preserve it as a curiosity it would be more efficient to install a modern steam pump.

Bucket chain pumps (Figure 37) are still in use in wells fifteen to thirty feet deep in many states. They are preferred by many farmers. The best of them have the machinery at the top of the well, covered so that there is very little chance of dirt or insects falling into the water. They have the advantage that as the buckets go down they carry air into the water, just as you would do if you inverted a tin cup and then pushed it down into the water.

Another kind of "chain pump" still used in America is an endless chain running over a grooved wheel down into the water, then through a wooden tube (see Figure 38). Rubber cups on the chain fit the hole in the tube, and as the chain travels up to the wheel the water must go up in advance of each cup (Figure 38). You can see how this kind of pump works if you take a long piece of glass tube or iron pipe, a strong piece

of twine, and a rubber ball or wad of cotton big enough to go through the tube. Drop the string through the

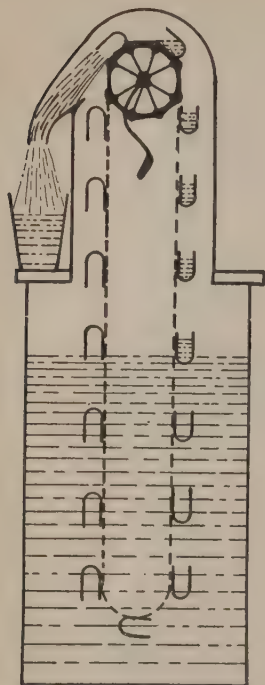


FIG. 37. A chain pump. The air in the tin cups escapes into the water as the cup starts on its way upward.

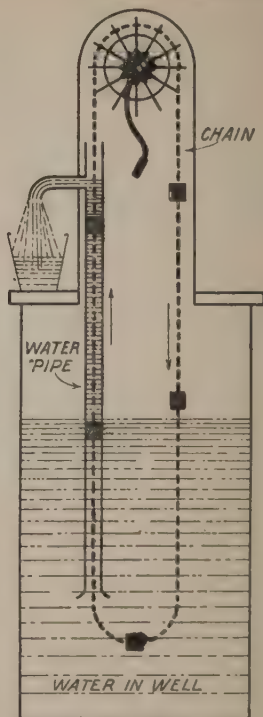


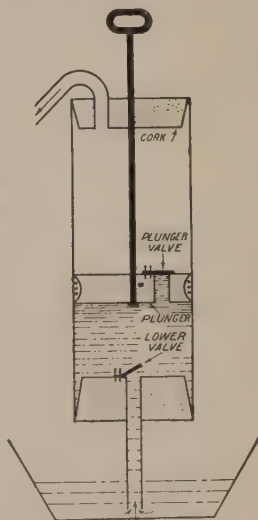
FIG. 38. This kind of chain pump has rubber cups which fit inside the water pipe and raise the water up the pipe to the spout of the pump.

tube, tie it to the rubber or cotton ball, hold the lower end of the tube in a deep pan or bucket filled with

water and slowly pull the string upward. What happens?

The most common kinds of pumps used in the United States are "suction" pumps. If you look at pictures of suction pumps in catalogues you will perhaps think that there are a great many kinds, but the fact is that

FIG. 39. A simple toy pump for studying the working of a "suction pump." One can be made from a gas-lamp chimney, three corks, some glass tubing, a piece of wire for the pump rod and handle, and two pieces of thin rubber for valves. (After Woodhull)



they all work in the same way. The simplest kind of suction pump is illustrated in Figure 39. You can make it with a glass tube or a straight lamp chimney for the pump cylinder, and three corks, one of which, used for the plunger, must be small enough to slip up and down inside the chimney. Make a pump rod or handle from a piece of wire or a small wooden rod. Make the valves out of pieces of rubber such as you

can cut from an old inner tube of an automobile tire, and fasten these valves with two pins so that the valves can flap up and down as water passes through the openings in the corks. To start, or prime, this simple pump, pour some water into the space above the plunger and put the lower end into a pan of water. When you pull the plunger up as far as it will go, you will see water rising from the tube into the lower part of the lamp chimney; then slowly push the plunger down and some of the water will run through the valve on the plunger into the upper part of the chimney. Then pull the plunger up again and you will see that the water above the valve runs out of the spout and more water rises from the pan into the lower part of the chimney. Move the plunger up and down slowly and watch the valves until you find out how this simple pump works.

Such a pump consisting of a cylinder and a plunger with two valves is known as a "suction pump" because it appears to suck up the water just as you do if you drink water through a straw.

"Suction" pumps like that in Figure 40 will raise water from wells about twenty-eight feet deep at sea level, but only very good and new pumps work very well if they have to "suck" water more than about twenty-five feet from the plunger to the surface of the water in the well. If the distance is much over twenty feet, it is best to place the pump cylinder lower in the well so that it will be within twenty feet of the water, or better still, immersed in the water as shown in

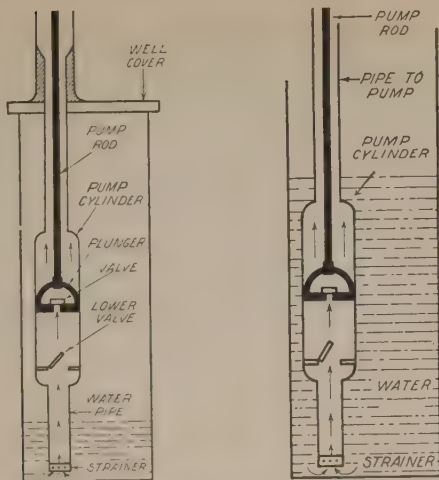


FIG. 40. The picture at the left shows a "suction pump." Notice the position of the two valves when the plunger is being lifted and water is "rising" in the pipe. If the water is more than about 25 feet below the lower valve, the cylinder should be placed in the water as in the picture at the right.

Figure 40 at the right. In some cases the pump cylinder is several hundred feet deep in the well and a slender pump rod of wood or metal moves up and down inside the pipe and so works the plunger.

Study Figure 40 and compare the pumps shown there with the simple pump made from a lamp chimney. The pump cylinder made of metal, preferably brass, corresponds to the lamp chimney. The metal plunger with a leather rim corresponds to the plunger we made from cork. Two leather or metal valves correspond to the rubber valves in our experimental pumps.



FIG. 41. Picture of the spillway of one of the great dams of the New York water system. Heavy rains and thawing snow have caused an overflow of millions of gallons of water per day. This spillway is 1200 feet long and 150 feet high — almost as high as Niagara Falls. (*Times Wide World Photos*)

It does not matter whether the cylinder of a suction pump is vertical as in Figure 40, or horizontal as in many pumps which are driven by engines and electric motors. Both kinds of pumps work equally well if the cylinders have tightly fitting plunger and valves.

The old-fashioned wooden suction pump which is still found in many parts of the United States is made on the same principle. Some of the very old ones were made from logs of wood with about a three-inch hole bored through them lengthwise. Such crude suction pumps were made fifty or sixty years ago by men who went around the country with a big auger for boring holes in suitable logs and with other tools and materials so that they could make a very satisfactory suction pump for the farmer or for any one who needed one. With the invention of machinery for

making such pumps in factories, the homemade type of suction pump was no longer desirable.

Force pumps. Another kind of pump which is necessary in many places for supplying water to homes and public buildings is known as the "force pump."

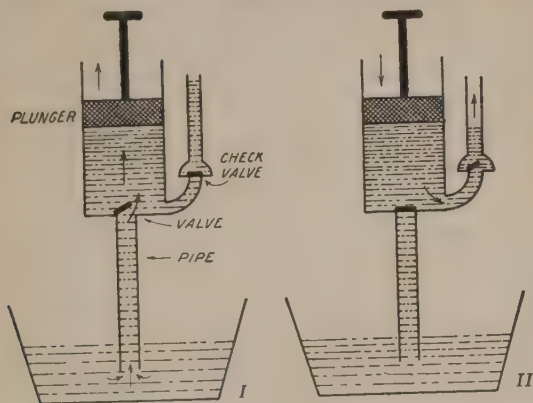


FIG. 42. Models showing how a force pump works. In model I the plunger is being drawn upwards and water is "rising" (forced by air pressure) from a tub up the pipe, through the lower valve into the cylinder. The check valve is closed. In model II the plunger is being pushed down, the lower valve is now closed, and the check valve is letting water up the pipe that may lead to a tank.

The way this kind of pump works is shown in Figure 42 (I and II). When the plunger is pulled up, water is first drawn through the lower valve into the cylinder (I), as in the ordinary "suction" pump, and then when (in II) the plunger moves downward the water is forced through a check valve. This prevents water from running back into the pump when the plunger

is again pulled up as in I. If we continue to move the plunger up and down, water can be forced to a great height if a long pipe is connected above the check valve. Such a pump could be placed in or near a spring or well and water be forced to a building on a hill which might be hundreds of feet above the well. Of course if water is to be forced very high a powerful engine or motor will be necessary to drive the pump.

Some force pumps in common use are suction pumps with a valve in the plunger like Figure 40, but with a nozzle for fastening a hose or pipe to the outlet. Another kind of force pump, which is also very common, is like Figure 42 (I, II), but the cylinder is immersed in the water which runs into the cylinder without "suction." You can easily imagine how water would be forced up the pipe when the plunger is worked up and down. A pump of this kind is often used by farmers for spraying their fruit trees with poisonous mixtures of Paris green, copper sulphate, and lime. In order to get a fine spray, great pressure is necessary in the hose, and this is obtained by having near the bottom of the barrel a brass cylinder with a plunger and two valves arranged as in Figure 42.

The force pump is necessary in all cases in which water must be lifted more than about twenty-five feet for use in homes and other buildings, and of course it is always necessary when water is being pumped into tanks, windmill towers, and reservoirs on hills. In short, the simple suction pump, which has been described in this chapter and shown in Figure 40, is

useful only when we wish to lift water not over twenty-five feet from a shallow well and the water runs directly into a bucket or tank. For practically all other purposes, some arrangement for forcing the water from the pump to a higher level is necessary. If you will look in catalogues of pumps, you will find it interesting to look over the pictures of the simple suction pumps and compare their construction with that of force pumps.

Running water in homes. Every one who lives on a farm or in a village where water is not pumped into the house gets tired of carrying water.

No doubt that was the feeling of Jack and Jill in the nursery rhyme when they "went up the hill to fetch a pail of water." Nowadays it would be a waste of work for the children to carry water downhill to the house because a few dollars' worth of iron pipe could be arranged so that the water could run down the hill and into the house. If the water supply is so located that water from it cannot run into the house, there are several simple ways of pumping water for home use. We can use either a hand pump which will raise water to the house, or force pumps which are driven by electric motors, gasoline, kerosene, steam, or hot-air engines.

Water in farm homes. Nearly a million farm homes in the United States have running water in them. About half a million of these homes are in New England and California. About one-fourth of them are in the states of New York, Pennsylvania, Oregon,

and Washington; and about one hundred and fifty thousand are in the states of the Corn Belt. Probably one explanation of the fact that there are so many more homes with running water in some states is that in a hilly country it is usually easier to arrange to supply water to the house, while in many regions where the water must be pumped from deep wells it is much more difficult and expensive to install a home water-supply system. It is interesting to note that in the Corn Belt States only one farmhouse in eight has running water in the house, while three-fourths of the farm homes in these states have telephones.

There are many farm homes where it may not be easy to arrange for running water, but where it would be easy to save a great deal of work for the women in the house by placing the pump in the house or in the cellar. If the water is in a near-by well or cistern and not over eighteen feet below the kitchen floor, a simple suction pump costing less than twelve dollars would lift the water to the kitchen sink. With a very good pump, the water could be lifted from a well a few feet deeper, but considerable muscular power is required to work such a pump.

There are other homes where the water in the well may be as much as twenty-five feet below the kitchen sink, but a hand pump fastened to the cellar floor would be seven to eight feet nearer the water. In such a case we would have to have a combination of a suction pump and force pump because the water would have to be sucked up to the pump in the cellar

and then forced up to the kitchen or other parts of the house. A good pump driven by a motor or engine will lift water twenty feet from a spring or well that is 150 feet to 200 feet from the house, but if the water must be lifted twenty-five feet from such a source, an extra good pump is necessary. In such cases it is better to place a force pump near the spring or well and force the water up into the house.

How water rises in pipes in houses. It is easy to understand how water can be forced by a pump through all the pipes in the house; usually, however, it is not forced but "runs" through the pipes. In order to understand how water may run in pipes to any part of a building, we need to remember some general facts concerning running water. You know that "water runs downhill." That of course is why water from rain runs in ditches, brooks, and rivers back to the sea.

In books on general science and physics, which you will study in high school, you will learn that water "runs downhill" for the same reason that bodies free to move will fall from a higher to a lower level on the surface of the earth. We know, also, that water, like stones, will fall to the bottom of a deep hole in the ground. It is believed that water would fall to the center of the earth if we had a hole reaching that far.

It is a well-known scientific fact that bodies, such as stones and water, fall as far as they can towards the center of the earth. In popular language we say that falling is due to "gravity" and any water supply system in which water runs downhill in pipes is called

a "gravity system." In all systems which have reservoirs on hills, tanks on high towers, or standpipes, water runs from these through pipes into one or many buildings where it is wanted.

Now, water can be made to "run uphill" or rise in pipes or tubes if we connect a "downhill" tube with



FIG. 43. This picture shows how the water in a U-shaped glass tube is "level," even though the tube is tipped almost enough to spill the water. Compare with the teakettle in Fig. 44.

an "uphill" one. If we pour water into one side of a tube which is bent like a letter U, the water will "run uphill" on the other side of the tube until, as we say, it is "level" (see left side of Figure 43).

If we incline the tube, the water moves so that there is more in one half of the tube, but still the water remains "level." Do you know how high water rises



FIG. 44. How high does water rise in the spout of a teakettle? Notice how the farmer made use of the answer to this question in the experiment shown in Fig. 45.

in the spout of a teakettle when the kettle stands flat on its bottom? Examine a teakettle filled with water and see if Figure 44 is correct. How high does the water rise when we pour from the spout?

If you ask a mechanic, such as a plumber, why the water rises in the spout of a teakettle or in the U-tube

you have noted, he will probably answer that it is because "water and all liquids always rise to their level." If you ask a carpenter what this means, he will probably show you the tool known as a "level." Examine one of these and you will see that it consists of a long piece of wood or iron, in the center of which is fastened a small glass tube so nearly filled with alcohol that there is just space for a small air bubble. When the carpenter lays this tool on the floor or on any place in a building he says it is "level" if the bubble is exactly in the center of the glass. If you lay a "carpenter's level" on a table, and with pieces of pasteboard raise the legs of the table until the bubble is in the exact center of the glass, you can make sure that the table "stands level." Then pour some water on the center of the level table. What happens? Then raise one side of the table. What happens? Why are cement roads and sidewalks and cellar floors not made "level"?

In order to find out how high water will rise in a house in a pipe which is connected with a pipe that carries water downhill, from a spring or tank, we can make use of a carpenter's level. For example, a farmer in Indiana wished to find out last year whether water would run from a spring on a hill into a tank in the attic of his house. He went to the spring with a carpenter's level which he placed on a flat rock near the spring. Next he raised one end of the level until the bubble was in the center of the glass. Then he looked or sighted over the top of his level, as you

would "sight" along the barrel of a gun, and he saw that a straight line would reach many feet above the house as in Figure 45. This proved that water would run into a storage tank in the attic if a pipe were laid underground down the hill and up into the house as shown in the picture.

If, when looking along the level, this farmer had seen the roof of his house in line, it would have been

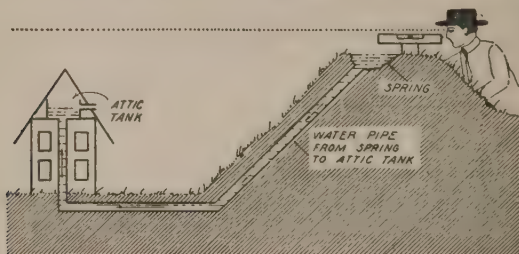


FIG. 45. This shows how a farmer used a carpenter's level to find out whether water would run from a spring on a hill to a storage tank in the attic of his house. He could have built a higher house or one on higher ground and still the water would have run into the tank.

wise for him to send for a surveyor who would use an instrument which has a level attached to a telescope mounted on a tripod and is very accurate for "leveling." Have you ever noticed that surveyors use such an instrument for deciding how deep ditches and sewers must be in order that the water may run properly? Such care is necessary whenever there is a very little slope to the ground. Once a farmer in Ohio spent hundreds of dollars in laying nearly half a mile of drain tile, two to four feet underground. When

the work was all done and heavy rains came, the whole drain was useless because the end at the river was several inches higher than the tile under the cornfield. This farmer's fields were so level that he should have employed a surveyor to make sure that every part of the ditch was graded so that the water would slowly "run downhill."

Now we understand how water "runs uphill" or rises in pipes until it reaches the level of the source of supply, which may be a spring or a pond on a hill, a tank on a windmill tower or in the attic. We shall now study the arrangement and working of a "gravity" water system for homes and later we shall study a system in which the water is forced through tanks by pumps.

Water storage tanks for homes. Sometimes hand force pumps are used for pumping water into storage tanks in houses; but if very much water is needed or if the water must be lifted eighteen to twenty-five feet by a suction pump, or raised more than twenty-five feet by a force pump, it is necessary to use some kind of power, such as that furnished by a windmill, electric motor or gasoline engine. In some places where fuel is cheap, hot-air engines are still in use.

The storage tank, whether of wood, metal or concrete, should be large enough so that the pump does not have to be started more than once a day. Storage tanks may be in the attic of the house, or on a tower or a hill which is higher than the top floor of the house. In such a system the water will flow to any

faucet which is lower than the outlet pipe at the bottom of the storage tank. All such arrangements in which the water flows from a storage tank are known as "gravity" water systems. Why the water will run from such a tank to all parts of the house is explained in another part of this lesson, page 104.

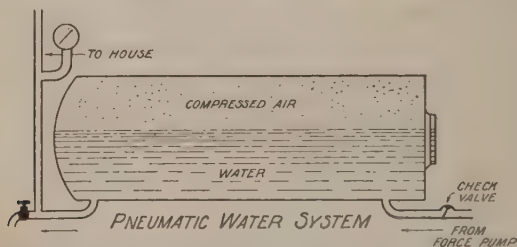


FIG. 46. Water from the pump is forced into the tank (which is an air-tight cylinder made of steel, like a steam boiler) until the air is compressed so that the pressure gauge shows 40 to 60 pounds. The check valve keeps the water from returning to the pump. The pipe carrying water to the house connects with such a system as is shown in Fig. 47. Water is forced up through the pipes in the house and may be drawn at any faucet until the pressure of the compressed air falls so low that it will not force the water up to the faucets. Then the pump must be started again.

Another kind of storage tank is a tight metal one which looks something like a steam boiler. These tanks are either placed in the cellar or in the ground so deep that there is no danger of freezing. In filling these tanks a valve is opened and air is allowed to enter. Then the valve is closed and water is forced in by the pump until the air is compressed at the top of the tank, as shown in Figure 46. When the pressure gauge shows twenty pounds, water will run from a pressure tank in the cellar to any faucet in a two-

story or three-story house, but if the tank is buried, at a lower level, as is often the case, a greater pressure will be necessary to force the water to the upper story of the house.

Until recently these pressure tanks were always large enough to hold a supply of water sufficient for some hours, or even for a day. Within the past few years an improvement has been made for use in any place where electrical power is available. This consists of a small tank holding about twenty gallons of water and compressed air. It is connected with an automatic electric pump which starts if the pressure in the tank falls to twenty pounds when water is drawn at any faucet in the house. The motor will stop when the pump has forced in enough water to raise the pressure to forty pounds. How long do you think such an automatic pump would run if the faucets were left open so that the pressure in the tank did not rise above twenty pounds?

Look in catalogues which describe water systems for farm and village homes and examine the pictures and descriptions of the apparatus for water systems which have been described in this chapter.

Study Figure 47 and starting with the supply pipe, which gets its water from a tank in the attic or a main pipe in the street, trace the path of the cold water through the pipes in the house. After reading about hot water on pages 109-111 you will be prepared to study the arrangement of hot water pipes as shown in Figure 47.

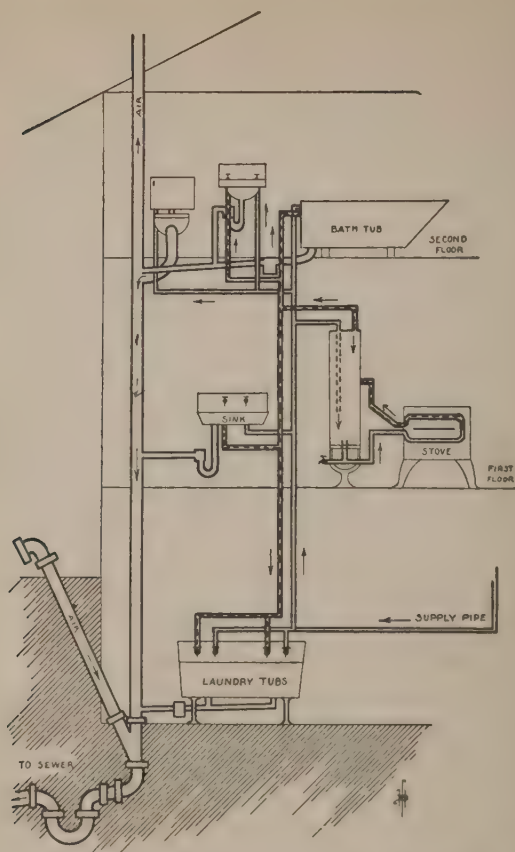


FIG. 47. This is a plan of a simple water system in a house. Trace the path of cold water from the supply pipe to laundry tubs, kitchen sink, range boiler, bathtub, washstand, and toilet. Now trace the path of hot water from the heater in the stove to bathtub, washstand, kitchen sink, and laundry tubs. Trace five branch drainpipes to main sewer pipe.

Hot water for cleanliness. You have already learned that warm water with soap is best for cleaning hands, clothes, floors, and dishes. For this reason health and comfort in the home depend very much on having an abundance of warm water, and sometimes hot water, for cleaning purposes.

The most primitive method of heating water consisted in putting stones into a fire and when they became red hot dropping them into buckets or barrels of water. This method was known to uncivilized people long ago, and even now when farmers want hot water and have no kettle at hand, they use this primitive way of heating water with hot stones. This way of heating water is very useful when you are camping and need warm water.

In the colonial days in the United States big iron kettles were hung on the cranes in the fireplaces and hot water was dipped out when needed. Of course this did not give enough warm water for a bathtub. The fact is that there was no such luxury as a bathtub with plumbing in those days, and people were lucky if they could get enough warm water to fill a washtub. Some very big fireplaces could hold kettles large enough to heat water for washing clothes, but usually on wash days the women built a fire around a big iron kettle hung on a tripod or set on stones outdoors. On some old farms there are still big kettles supported by a brick furnace and with some kind of roof so that they can be used on rainy days.

Many cook stoves or kitchen ranges are made with

water tanks or reservoirs so built into the back part of the stove that water is warmed by the heat on its way around the oven. Usually this arrangement is not

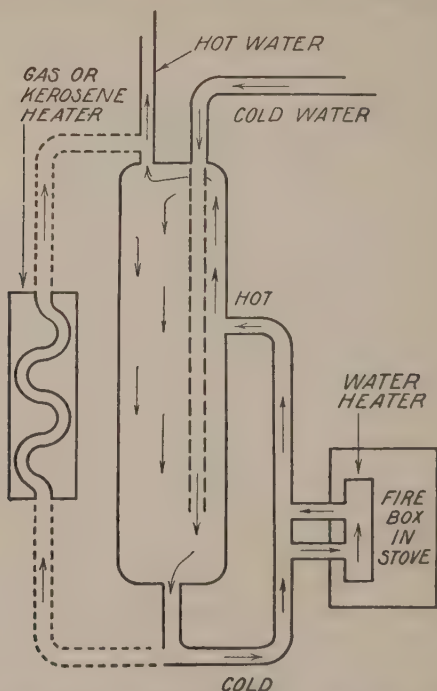


FIG. 48. Diagram of a range-boiler with a stove on the right and kerosene heater on the left. Trace cold water from the supply pipe, through the stove, to the hot-water pipe that leads to the bathroom. Compare with Fig. 47.

very satisfactory because it takes a large amount of fuel and often interferes with baking because the water takes up so much heat.

Many houses with running water now have "range boilers" holding thirty to fifty gallons, placed usually in a corner back of the kitchen stove. These boilers are connected by metal pipes with a "water heater" in the fire box of the kitchen stove, the furnace, the steam heater, the hot water heater in the cellar, or a gas heater either in the cellar or the kitchen. The arrows in Figure 48 show how the water circulates. Cold water from the storage tank or water system that supplies the house with water flows down a pipe inside the range boiler (see dotted lines) and down to the lower part of the water heater in the fire box. As soon as this water is heated, it rises from the heater up a pipe which is connected about the middle of the boiler, as shown in the picture. Inside the boiler there are currents of warm water, as shown by the arrows. If no warm water is drawn at a faucet for some time, the water in the boiler becomes warmer and warmer, the coolest water goes to the heater, and after a time all the water in the range boiler may become boiling hot. These range boilers are made strong enough to withstand a certain amount of internal pressure from steam, but they need to be watched if hot water is not being used.

When a "hot-water" faucet (is it usually the right or left one?) is opened anywhere in the house, the warmest water rises from the top of the range boiler and an equal amount of cold water enters from the supply pipe. This cold water flows as rapidly as possible through the heater, and from this it rises to

the boiler and takes the place of warm water drawn off at a faucet.

Gas and kerosene heaters are coming into use for rapid heating of water. They are connected as shown by the dotted line at the left in Figure 48. They work as follows: A small pilot flame is kept burning constantly so as to light gas or kerosene when the valve of the burner is opened. If a faucet is opened anywhere in the house, the warm water begins to flow from the pipe above the gas heater and then an automatic arrangement turns on more gas or kerosene so as to make a hotter flame around the numerous coils of the heater. The water is then heated rapidly and, as shown by the arrows at the left in Figure 48, it rises directly into the pipe that leads to the hot-water faucets of the house. If the gas heater were connected to the middle of the boiler, like the ordinary stove heater, shown on the right side of Figure 48, one would have to wait until many gallons of water were heated before getting hot water at the faucet. The chief reason for having kerosene or gas heaters is to get very rapid heating of water when it is needed.

It is not necessary to have a range boiler if all the water used is heated by a gas heater. We could simply connect the bottom of the gas heater with a cold-water supply pipe and the top of the heater with a pipe leading to the hot-water faucets and it would work very well. However, it would be an advantage to have at least a small range boiler in which some warm water could accumulate as it is heated by

the pilot flame. The reason why many people prefer to have both kinds of heaters, as shown in Figure 48, is that the heater in the stove keeps the range boiler full of warm water and the gas or kerosene heater is in reserve for use when the fire in the stove is low or not burning, as in warm weather.

In lighting gas or kerosene water heaters, it is very important to follow the directions given by the manufacturers. It is specially dangerous to hold a lighted match or kerosene lamp near the heaters when the pilot flame has gone out and the gas has not been turned off. If anything goes wrong with the burner, it is best to investigate in daylight or with the aid of an electric flashlight. If any gas has escaped, open the heater and allow thorough ventilation before trying to light the burner again. Neglect of these precautions has resulted in some very serious explosions.

Storage of rain water. In many parts of the United States rain water or melted snow is stored in tanks

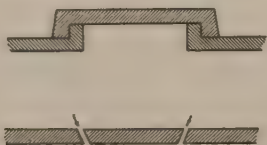


FIG. 49. Two kinds of covers for wells or cisterns. Rain water sometimes floods the top of a cistern. Which of these covers is better for keeping dirty water out of the cistern?

and cisterns, either because there is not a sufficient supply of water from springs or wells, or because such water is so charged with mineral matter that it is not

good for drinking or household purposes. In most cases the water is stored for washing clothing. In some places the water from springs and wells is so "alkaline," or charged with minerals, that it is not drinkable. Such water comes from some springs and wells in the states east of the Mississippi; and many of the lakes and streams in the dry lands of the western states have strongly alkaline water because there is much mineral matter in the soil in this region. That is the reason why the waters in Great Salt Lake in Utah and the Salton Sea in California are highly charged with salt and other alkaline materials. In such regions stored rain water is very necessary for drinking and for household purposes, unless water can be piped from springs or brooks in the mountains.

In many desert regions in various parts of the world, the inhabitants have some interesting methods of storing rain water. In parts of the Sudan, which you should look for in a map of northern Africa in your geography, the natives use the hollows in large trees as reservoirs for storing rain water, which falls only in July, August and September. They use a kind of tree which naturally has hollows, due to the decay of the heart wood, and these cavities are enlarged so as to make big living tanks. Rain water is collected during the rainy season and carried in crude leather buckets and poured into the hollows of such trees. Some of these trees hold ten to twenty barrels of rain water.

Rain water as it falls from the clouds is almost pure, but often contains some dust, acid, and ammonia,

washed out of the air, especially during the first part of a storm. It is purest if caught in earthenware or glass dishes set in the open so that water from buildings and trees cannot splash into them. In fact, rain water so caught is pure enough to use instead of distilled water in automobile batteries.

The chief difficulty in storing rain water is that it is hard to keep it as pure as it is when it falls from the clouds. Cisterns or tanks, made of wood, brick and stone, galvanized iron and cement, are commonly used in the United States. They should be carefully covered so that dust, insects, mice, etc. cannot enter. On many farms there are uncovered cisterns into which insects, rats, pigs and chickens may fall; and many children have been drowned because cisterns did not have covers. Some cisterns have screens or gratings for the purpose of letting any spilled water run back, but this is wrong because such screens allow dust and insects to get into the cistern.

Uncovered cisterns, water tanks, rain water barrels and buckets are ideal places for breeding mosquitoes. They are sure to flourish in rain water which is left uncovered. Many times people in regions where there are no stagnant pools wonder why they are disturbed by mosquitoes, but careful examination of unprotected rain water shows that it is full of the larvæ such as are shown in Figure 50. Since mosquitoes are dangerous to health, as stated in Chapter VII, it is especially important that they should not have a chance to breed in stored rain water. If the rain water is

to be used only for washing clothing, a small amount of kerosene may be poured on the surface of the water to keep the mosquitoes from developing, but of course this method could not be used in places where the rain water is necessary for drinking.

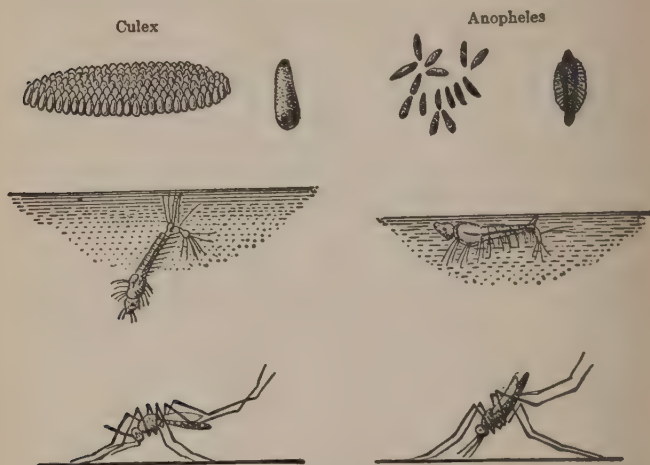


FIG. 50. Mosquitoes breed in stored rain water. The left half of the picture shows eggs, larva, and adult of the common mosquito (*Culex*); the right half shows the malaria-carrying mosquito (*Anopheles*). Notice the different positions of the larvae and adults of these two kinds. (After Howard)

The care of cisterns in order to make them sanitary consists in keeping out all dust and other impurities. To do this, water from a dirty roof must be run into the drain until the shingles are washed clean; if possible, the water should run through a filter of clean sand and charcoal before it enters the cistern.

Every cistern should be scrubbed once or twice a year. This should be done when the water is low, because then less water will be wasted.

If you have anything to do with the building or care of cisterns at your home, you will find much useful information in pamphlets prepared by the United States Department of Agriculture at Washington, D. C. These pamphlets will be sent to you if you write to the department or if you write to the congressman who represents your part of the state at Washington. Ask for pamphlets concerning water supplies for farm homes and you will get the latest information.

Public water supply. As we have learned, an abundance of pure water is necessary for health. In the country and in any small village it is usually possible to get such water from wells located near the separate homes, but as a village grows into a town, and a town into a city, the houses are built closer and closer together and unless a sewage system is installed the water in the wells and springs is almost sure to become polluted and dangerous to health. It is therefore necessary that, when houses are built close together, there should be some kind of public water supply in order to furnish pure water and in order to wash away sewage. The importance of this fact has become so generally recognized in the United States that there are few towns of more than two thousand people without water systems, and there are thousands of villages and communities of two to five hundred people which have joined in securing a common or public water system.

There is another reason for public water systems, namely, there could not be enough wells and springs in a city to supply the necessary water. For example, New York City uses all the water from the rainfall on a area several times larger than that occupied by the city. The rainfall from over one thousand square miles of land collects in several reservoirs, and most of it is distributed to about one hundred and fifty square miles of the most densely populated parts of Greater New York City.

Ancient water systems. The importance of public water systems was known several thousand years ago. Explorers who have dug up the ruins of old Jerusalem have found big pipes or conduits built of brick and mortar. The ancient city of Carthage and some of the cities of ancient Greece had conduits for bringing water from the hills in the country to the city.

The ancient city of Rome obtained its water from the river Tiber and from wells until there were so many people that the water of the river and wells became polluted and pure water had to be piped long distances from the hills and mountains. A wonderful system of aqueducts was built about two thousand years ago and some parts of these works still stand, but to a large extent they were destroyed when Rome was captured by the barbarians in the fifth century A.D. In all these ancient water works there was no general distribution to separate houses as in our towns and villages in the United States. The big water pipes or aqueducts poured their water into large cisterns or

reservoirs and then lead pipes were connected with public baths, fountains and smaller reservoirs. Rome at one time had nearly one thousand public baths and over one thousand public fountains. Only the very wealthy people could have water piped into small



FIG. 51. This picture shows the ruins of an old aqueduct which brought water into Rome. The water was carried in two different pipes or channels, one above the other, on top of these arches. (*After Herschel*)

reservoirs in their own homes. Most of the people had to carry water from the public fountains.

In Europe during the Middle Ages, most of the towns and cities had polluted water supplies, and terrible epidemics of disease were very common. Even in the year 1500 Paris supplied only one quart a day per person and the inhabitants had to get most of their water from the river Seine. The Moors, who occupied Spain, built some good water systems about the years 1000 to 1200 A.D. They also repaired some systems which the Romans had built nearly a thousand years earlier. In London, in

Germany and in one city in Mexico important improvements in the public water supply were made about the years 1500 to 1600. In the last two hundred years there has been a rapid improvement in water systems all over the civilized world and the result is that diseases caused by using impure water are becoming less common every year. At the same time people who are living in the cities are becoming cleaner and cleaner and are keeping their cities cleaner, and in this way becoming more healthful and self-respecting.

Modern water systems. The water systems for towns and cities are like some of the home systems but on a much larger scale. The pneumatic or air pressure system is only suitable for home use because it would not be economical to build air-tight tanks large enough to supply even a small town.

Many of the American towns and cities get their water by a "gravity system" from lakes or artificial reservoirs that are at a higher level than the buildings into which the water runs. These work just like a home system in which water is piped from a spring on a hill to a house below. New York, Boston, Los Angeles and numerous smaller cities which obtain water from hills and mountains have "gravity" systems.

The largest and most wonderful "gravity" system in the world supplies Greater New York City. The oldest part of the system, the Croton, still supplies about half of the water used daily. Thirty miles north of the City is the Croton Lake, formed by the great Croton Dam. Many miles back in the hills are

ten other dams and six lakes that hold water in reserve for use in very dry seasons when the Croton Dam might not hold enough for the needs of the city. All around the Croton system is a great reservation or park from which dwellings and farm buildings have been removed so as to prevent contamination of the soil and therefore of the water. In fact, so important is it to keep people from living on the land which drains into the Croton reservoir that a state institution for sick people, costing millions of dollars, was closed because the sanitary engineers decided that the sewage from that institution might get into the lake and spread disease germs among people in New York City.

From the Croton Dam the water runs in a great pipe or aqueduct, most of which is buried underground, to New York City. The lake is so much higher than the city that water runs to the top of ordinary buildings, but it must be pumped to tanks on the tops of the very tall buildings. For this purpose, every tall building has its own pump. Fire engines with force pumps driven by steam or gasoline are also necessary in order to throw streams of water to the top of tall buildings.

When the Croton system was built over eighty years ago (1842), it was planned to provide enough water for all the people who might live in the city a hundred years later, but within forty years after it was built the city was growing so rapidly that the engineers saw the danger of a shortage of water unless a new supply could be added to the Croton system.

In order to secure an additional supply, the city of New York built, at a cost of \$185,000,000, the great Catskill system, ninety miles northwest of the city and on the west side of the Hudson River, just south of the Catskill Mountains where Rip Van Winkle took his long sleep. The great Ashokan Dam was completed in 1917 and a beautiful lake over fifteen miles long is now located where twenty years ago there were farms and villages. In order to get still more water, New York City has recently cut through one of the Catskill Mountains the longest tunnel in the world and through that tunnel the water from another valley now runs into the Ashokan Reservoir. The rainfall on 570 square miles of land is now collected into the reservoir, and it could supply New York City with 600,000,000 gallons of water every day in the year.

The aqueduct that brings water from the Ashokan Dam to New York City is very remarkable. Two steel tubes, each about twelve feet in diameter, are imbedded in concrete. At the crossing of the Hudson River near Storm King Mountain, the tubes extend down 1100 feet below the surface of the water, making a U-shaped siphon. This was necessary because at the place of crossing, the bed of the Hudson is filled with mud 700 feet deep, and the construction engineers had to tunnel down 1100 feet in order to find rock strong enough to stand the enormous pressure of the water.

Under New York City the Catskill water flows through eighteen miles of cement-lined tunnel in solid rock two hundred to seven hundred feet below the

surface. Steel pipes connect this tunnel to the main pipes under the streets.

In order to aërate or get air into the water before it enters the pipe that leads to New York City, the water is sprayed into the air at a place just below the Ashokan Dam. Sixteen hundred nozzles spray water high into the air and on a sunshiny day these sprays make one of the most beautiful fountains in America, and some travelers say they are as fine as the famous ones which Louis XIV had built in the palace grounds at Versailles in France. A similar aërating plant is at Kensico Dam, near New York City, where there is stored enough Catskill water to supply the city several months if the great aqueduct leading seventy-five miles to the Catskill Mountains should be put out of commission.

Hundreds of towns and cities in America cannot use the gravity system because they are not near enough to hills or mountains where water can be obtained. It is probable that in the future water will be piped long distances. The new systems at Los Angeles and San Francisco, California, extend to mountains more than a hundred miles away. This makes it seem possible that some day aqueducts a thousand miles long may be built, so that water from the mountains may be brought to distant cities which need it. At present, however, very many cities must pump their water from rivers and lakes. Philadelphia pumps water from the Schuylkill River; only a few years ago it was regarded as a very dangerous water supply, but now

a wonderful filtration plant purifies the dirty river water. Chicago, Milwaukee, and Cleveland pump their water from the Great Lakes. At Chicago the main water pipe of the pumping station extends about four miles out into the lake so as to remove the danger of taking in unsafe water from near the shore. Even at this distance the lake water was very much polluted by sewage until about thirty years ago when the Chicago drainage canal was excavated. Since this canal was opened, some water from Lake Michigan is constantly running through the drainage canal and washing the sewage into one of the branches of the Mississippi. The water pumped from the lake is now much purer. Bacteriologists have shown that all the dangerous germs in the sewage are probably destroyed before the water reaches the Mississippi and therefore there is little danger of spreading disease germs to the cities along the banks of that river.

Hundreds of towns and cities get their water supply from wells. Even cities as large as Memphis, Tennessee, Savannah, Georgia, and Galveston, Texas, get their water supply in this way. The old system in Brooklyn, New York, which is now held as a reserve, had a large number of wells. In some cases very large wells, eighty to one hundred feet in diameter, are dug, but wells thirty to fifty feet are most common. Most American towns which use wells have bored ones lined with metal pipes which are two inches to two feet in diameter. When small pipes are used, there are usually dozens of wells from twenty-five to one

hundred feet apart. In Europe there are many bored wells from four to six feet in diameter.

All towns and cities which get their water from lakes, rivers, and wells must have pumping stations. The first use of steam pumps was in London and Paris between 1760 and 1780. Usually the water is pumped into reservoirs or tanks located on hills, into tall "standpipes" made of steel (Figure 52), or into large

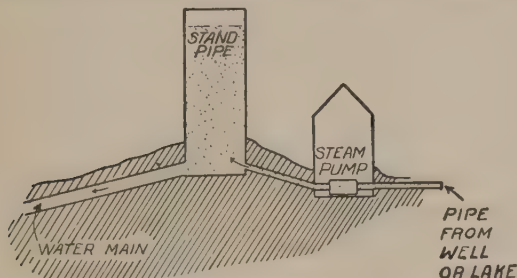


FIG. 52. Standpipes, made of steel or concrete, are used where the reservoir cannot be located on an elevation sufficiently high to give the desired pressure in a gravity water system. Water is pumped into the standpipe from a well, lake, or river, and the standpipe kept almost full. Notice that the water main is connected with the bottom of the standpipe.

tanks placed on tall steel or concrete towers. Water runs from these reservoirs into the main water pipes in the same way as in a "gravity system." If one rides in a railroad train across the level parts of the United States, he will see many standpipes and water towers located where there are no hills on which reservoirs could be built. Figure 52 shows how a standpipe is connected at the bottom to the pump and to the main pipes.

You have now learned many of the most important things about water supply systems which are used in American towns and cities, and you are prepared to find out how water is supplied in your own neighborhood. As soon as you find out all the facts which you can concerning the water supply in your own town or city, make a report to your teacher.

How water is purified. Many of the towns and cities which get their water supplies from lakes and rivers have filtration plants where the water is allowed to run through beds of fine sand which take out or destroy the bacteria. Philadelphia, Albany, St. Louis, and many other cities located on rivers have successful filtration plants for purifying the water before it runs into the main pipes.

Chemicals like chlorine are extensively used for killing bacteria which may be in the water in the main pipes. You probably know the yellowish-white powder

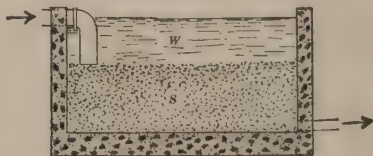


FIG. 53. This slow sand filter for water is about eight feet deep — five feet of sand (S) covered by three feet of water (W). The water which passes through such a filter usually comes out clear at the bottom; it also leaves behind in the sand most of the bacteria and other foreign substances.

called “chlorinated lime” or “chloride of lime,” which is sold in tight cans by grocers or druggists. You know that it is used for killing germs, that is, for dis-

infecting. The reason it kills them is that as soon as the powder is moistened chlorine gas is given off and acts on bacteria. A very small quantity of chlorine in a large amount of water will kill all the disease germs that may be present. In many cities the water is made safe by using one part of chlorine for each million parts of water.

If any pupils in your class have never smelled chlorine gas, bring a very small quantity of chloride of lime to school so that every one may notice the

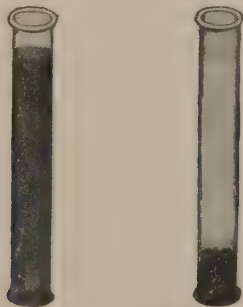


FIG. 54. Very cloudy water is sometimes cleared by treating it with chemicals, such as alum salts. The water in the tube on the right has been treated with alum salts. Notice how much clearer it is.

peculiar odor which will soon penetrate the air of the room if it is left uncovered.

Since "chloride of lime" when put into water will kill disease germs, it is often used for disinfecting swimming pools in schools and public bathing pools, but it is less satisfactory for disinfecting drinking

water because it may leave a bad flavor due to the lime which remains after the chlorine has been freed.

Pure chlorine is now often used for purifying drinking water. Chemists can make the pure gas from common salt. It would not be convenient to make chlorine where needed to purify water in the main pipes, but fortunately it can be compressed into liquid

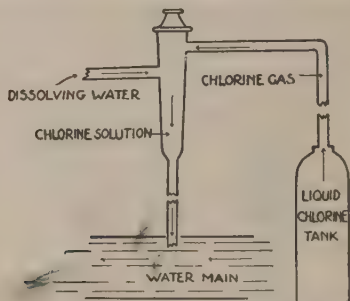


FIG. 55. When liquid chlorine is used in purifying water, it changes into chlorine gas and is dissolved in water in a small cylinder. The chlorine solution so made flows into the main water supply. (Broadhurst, *"Home and Community Hygiene,"* Lippincott)

form just as air is compressed into a liquid. Metal cylinders containing about 100 pounds of liquid chlorine are filled in chemical factories and sent to the chlorinating stations where the metal cylinder containing the chlorine is connected with the main water pipes. By means of a regulating valve the pressure in the cylinder is reduced and the liquid chlorine changes to a gas which is dissolved in water to make a chlorine solution which flows into the water main. In most

cases the chlorine soon decreases so that it cannot be tasted in the water.

Chlorine for purifying water is now used in hundreds of towns and cities of the United States. It was used constantly in the water supplied to the camps of the United States Army in France during the Great War, and the result was that the soldiers did not get the germs of typhoid from their drinking water. Even the remarkably pure water which is supplied to New York City from the hills and mountains is now treated with chlorine because there is always the possibility that some disease bacteria might get into the lakes of the Croton and Catskill systems.

Water for use in schools. Health in schools is often affected by the water supply. In order to develop habits of personal neatness, it is important that every school should have plenty of water for washing purposes; because, as you have already learned, dirty hands are very likely to carry disease germs into the mouth. The drinking water should be pure, for there have been in the United States many schools in which impure drinking water has spread disease germs among the pupils.

In towns and cities which have water systems, school-houses should have sanitary drinking fountains. The best kinds throw a small stream or jet of water from which it is easy to drink without touching the lips to anything but the running water. Hands and mouths should never touch the nozzles of a drinking fountain. Why is this so?

In some schools there are faucets from which paper cups can be filled with water, but it sometimes happens that the supply of cups becomes exhausted and

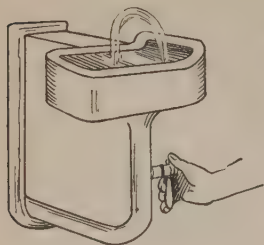


FIG. 56. This drinking fountain has three very good points: (1) it has a rim which is higher than the nozzle and extends around it so that people have to drink from the top of the jet of water instead of from the nozzle; (2) it is made of porcelain and is easy to keep clean; (3) there are no projections which might injure the mouth or face.

then several pupils use the same cup. Why should this not be done? In other schools, each pupil is required to have his own glass or cup, but pupils often forget the rules and exchange cups; often, too, the cups are not washed properly. If in your school each pupil has his own glass or cup, there should be a regular time for washing them, at least twice each week, with soap and warm water; and after washing they should be well rinsed in clean water.

Since paper cups are not always available, and individual drinking cups are not easily kept clean in schools, it is best to have drinking fountains wherever there is safe water in sufficient quantity.

Pure running water for fountains is not available in most country schools and in many village schools, but thousands of such schools now have portable drinking fountains that hold about five gallons of water. These fountains cost about \$15. The nozzles

on these are similar to those used where there is running water, and are so arranged that the children cannot place their lips on the nozzles. The jars or bottles which hold the water should be carefully cleaned once or twice a week, and they should be emptied and filled with fresh water every day.

If a school has only ordinary "water coolers," paper cups or individual glasses should be used; and, as you have learned before, such glasses should be cleaned frequently.

The old-fashioned water bucket with the long-handled dipper has been banished from all schools

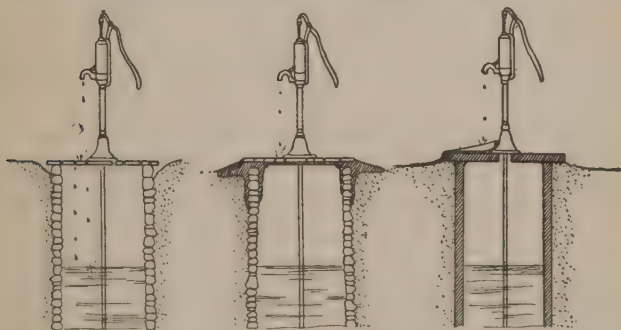


FIG. 57. Which well will let dirty water drip through the cover? Which one will turn or shed water away from the sides of the well?

where great care is taken to protect the health of the children; but such buckets and dippers are still used in some schools in which the teacher and pupils have not learned that we should not drink from a cup which has been used by other people unless it has been

washed carefully. If a bucket is the only way water can be carried into your school, then a dipper should be used only for filling glasses or paper cups. It should never be touched to any person's lips and it should be kept clean.

The facts which you have learned about drinking water are very important. Probably the best reason why schools should follow the rules already given is that drinking cups used by a number of people are very likely to transfer the germs of "bad colds" and certain kinds of "sore throats." In many districts in which these diseases were very common, the school doctors have found that there were fewer cases as soon as buckets with dippers and common drinking vessels were thrown away and a simple drinking fountain placed in the schools. There is no doubt about the statement made by doctors that many common diseases of school children are due to drinking from the same cup or dipper. That is the reason why the laws in many states prohibit public drinking cups which were once used everywhere. Have you noticed that in many railroad trains and stations only paper cups are supplied, except in the dining cars where warm, soapy water is used for washing the glasses?

In some states the laws prohibit the use of glasses and cups at public drinking fountains and in some states paper cups must be used by dealers in lemonade, pop, and other "soft drinks" unless they can show inspectors that they have plenty of warm water for washing glasses. That is the reason why

many roadside dealers sell tourists drinks which must be sucked from the bottle by means of a straw unless the buyer has his own cup or pays a penny for a paper one.

You have already learned that warm water with soap is best for washing dirty hands. In country schools, as well as in city schools, we often find boys with dirty and often rough and "chapped" hands because they have no chance to wash in warm soapy water. In many country schools there is cold water, but no soap is supplied. In some schools the children have contributed a penny each and bought their own supply of soap, but most school directors or trustees and county superintendents have learned that soap is important and now supply it for use in all schools in their charge. If you know any one who does not believe that there should be soap in schools, ask him to read this lesson. Perhaps you could get the older people in your neighborhood interested in having not only soap but also good drinking water in your school.

Can you suggest any way of having warm water and soap for washing hands at your school? This question will be most useful to pupils in many country and village schools.

If you cannot wash your hands properly at school, be sure to wash them carefully with warm, soapy water as soon as you go home from school. This especially applies to boys because in many of their games, such as football, they get their hands very

dirty, and if not properly washed, their hands soon get into very bad condition.

Drinking water in the home. Everything you have learned concerning drinking water in the school should be applied in the home. There are many homes, even in the big cities, in which one drinking cup or dipper is used by all members of the family and others who visit the family. The result is much unnecessary spread of disease, such as colds, sore throats, and even very serious diseases such as tuberculosis. Refusing to drink from cups and glasses which other members of your family have just used does not imply that you think them dirty; the bacteriologists now know that even people who look healthy and who are very clean in their habits may at any time transmit or pass on to other people through drinking vessels the germs of disease, especially of colds and sore throats. It is therefore best to be careful at all times, and members of a family should apply all the rules concerning drinking cups which you have learned in this lesson. The most important of these rules is that there should not be a dipper which people use both for dipping and drinking water. Dippers should be used *only* for filling other drinking vessels. Drinking from the edge of a dipper and then putting it back into a bucket of water is a dirty and a dangerous habit.

Ice and iced water. In towns and cities which have water systems the water in the pipes sometimes becomes so warm that ice is used to cool it to make it more refreshing for drinking.

As you know, much natural ice in northern states is cut from ponds and rivers in the winter time and stored in ice-houses until warm weather. This was the only ice our grandfathers could get, because ice-making machinery did not exist in their time. Now artificial ice is as cheap as natural ice and it is the only kind of ice sold in the warmer parts of the United States. If the cost of cutting, storing, and shipping natural ice rises much more, it will not be profitable to sell it in competition with artificial ice in the big cities. It is no longer profitable to ship large quantities of natural ice into the states where ice is never thick enough to cut for storage.

To some extent health is affected by the purity of ice. During the freezing of ponds and streams a certain amount of purifying takes place by settling. Have you ever noticed very clear ice at any place where the water underneath was muddy? If you live in a cold region, you can try an experiment by stirring some mud in water and then leaving it outdoors until a layer of ice freezes on the surface. Later examine the ice and notice that the mud has settled and left clear ice on the surface. When the particles of mud and other substances settle during the freezing of ice, any bacteria in the water are likely to be carried down into the unfrozen water beneath, but there is always a chance that ice from ponds where the water is not pure may contain some germs of disease. At any rate we do not like to drink water from a dirty pond. It is best therefore not to cool drinking water by placing

ice in the water; instead, the ice should be in a separate chamber so that the melting ice does not mix with the drinking water. Many water coolers are made so as to avoid this. Some of them have coils of metal pipe surrounded by melting ice and when the faucet is opened drinking water runs through the coils. Some of them have the ice in a metal container which is set in the center of a large jar of water.

If ice is ever placed in drinking water or on pieces of fruit, such as melon, only ice that is guaranteed pure should be used. As a rule artificial ice is best for such purposes, because much of it is made from pure water. In some towns and cities the health officers and doctors can tell whether the natural ice sold is pure enough for use in drinking water, and if you are in doubt about the purity of either water or ice, it is best to consult such experts.

THINGS TO DO

I. Test yourself! Can you finish the following sentences?

1. If we do not have pure water to drink
.....
2. If we do not drink enough water
.....
3. If we do not have enough water to keep clean
.....
4. If we collect dry soil, rotten leaves, etc., from the bed of a dried-up pool or pond and moisten them with boiled water

5. If we put dormant seeds into water
6. Our bodies are largely made up of water, in fact about
7. If grass is weighed when freshly cut and again when dried
8. Water does two important things in our bodies:
 - a. It dissolves
 - b. It absorbs
9. Cities need a great deal of water because water has so many uses.
 - a. People must drink it to
 - b. People need it to keep themselves.
.
 - c. It is needed for cleaning
 - d. It is needed for preparing and
 - e. It is needed for making
 - f. It is needed for putting out
 - g. It is needed for flushing
10. As far back as history goes, human beings have always planned

II. Choose one of the following things to do.

1. Trace the development of water supply from primitive times to the present day.
2. Trace a drop of water from the clouds to the earth and back.
3. Gather or make a collection of pictures that show ways of getting and storing water.
4. Make a study of different kinds of pumps and how they work.
5. Make a study of water tanks and private water systems.
6. Find out about various ways of heating water for household use.
7. Find out how to rid a neighborhood of mosquitoes.

8. Find out about the water supply of these places:

Old Jerusalem	Modern Jerusalem
Ancient Carthage	Tangier
Cities of Ancient Greece	Modern Grecian cities
Ancient Rome	Modern Rome
Paris in 1500	Paris today
London in 1500	London today
Old New York City	New York today
Your city long ago	Your city today

Also of Boston, Los Angeles, Philadelphia, Albany, St. Louis, Detroit, Chicago, Milwaukee, Cleveland, Memphis, Galveston.

III. Choose some of the following things to make:

1. Posters or slogans that will remind people not to use water in unsanitary ways.
2. Posters or slogans that will encourage people to use water in ways that will improve their health.
3. A set of three cartoons to show how a water supply is polluted, what happens then, and what should be done about it.

IV. The answers to these questions can be found by reading other books.

1. How are large cities in China supplied with water?
2. In what parts of the world must people buy water?
3. What is distilled water?
4. Where is the world's largest irrigation dam?
5. How are swamps drained?
6. How do forests help to store water?
7. How can floods be avoided?
8. How can droughts be avoided?
9. Where is the world's heaviest rainfall?

CHAPTER III

HEALTHFUL HEATING OF OUR BUILDINGS

Keeping the human body warm. The fact that the bodies of human beings are not covered with a coat of fur or hair made it necessary for even primitive people in cold climates to keep their bodies warm in two ways, by clothing and by fire.

The clothing of these early people was made from the skins of wild animals, and even now the skins of animals furnish us with clothing materials in the form of fur, leather, and wool. Silk is also an animal product that makes excellent clothing. It is probable that the use of plant materials for clothing was developed in regions where fur-bearing animals were not obtainable. The barks and leaves of trees are still used in some far-away islands for making crude kinds of clothing, and primitive people long ago learned the art of weaving cloth from plant fibers. Civilized people now use the fibers of cotton and linen in making a large part of their clothing. Even in the cold parts of the United States a large amount of these plant fibers enters into the composition of much of the clothing worn in winter. "Artificial silk" is a modern invention and not a natural source of clothing. It is made from sawdust and low-grade cotton.

No one knows exactly when the people of long ago learned to use fire for the purpose of keeping their bodies warm, but we feel sure that very early they began to use fire for warmth as well as for cooking food. Probably the first people in cold countries learned that fire would keep them warm and comfortable when they happened to go near fires which were started naturally, as when lightning starts forest fires. Having learned by such experience that the heat from fires felt good on their cold skins and having noticed what kinds of materials would make fires, it probably did not take the primitive people very long to find out that they could collect wood and keep it burning for warming their bodies or cooking food. It seems likely that primitive people first built fires outdoors near their caves, huts, or tents made of skins. When we go camping we like to build a fire in the open and then sit and sleep near it.

The desire for heat to keep the body warm and comfortable is not limited to humans, for many animals we know prefer places where they can keep warm. Dogs and cats enjoy a warm place behind the stove or near a heater, and on cold days in winter horses and cows will, if possible, stand in sheltered places where the sunlight strikes them and the air is warmest. Do you know where flies prefer to rest if they get into a house on a frosty day in autumn? What other animals have you seen trying to find a warm place? What is meant by the popular expression "a place in the sun"?

Old ways of heating homes. The simplest heating of homes is by an open fire in the center of a primitive home, such as an Indian wigwam, a rude hut or an Eskimo snow house. The smoke goes out of an opening at the top. See Figure 74. Such a simple way of heating a home is still found in Alaska, in Greenland, and wherever there are more or less uncivilized people living in wigwams and huts. In many of these cases a rather crude fireplace without a chimney is built of stones in the center of the room.

The next step in the improvement of ways of heating houses consisted in building a chimney over the open fire. In some of the old log houses, which the early settlers of this country first built, there was a kind of double fireplace with a chimney in the center of the main room of the house. This had the advantage that heat was distributed in every direction; but it had many disadvantages, especially because it occupied too large a space and interfered with the proper lighting of the room.

The next improvement consisted in building the fireplace at one side of the room. That location of the fireplace is the one which has been the most common for several hundred years, and is still popular in many parts of America and Europe.

You now have a general idea how very simple the methods of keeping warm were before man invented stoves and furnaces and other heating apparatus about which you will read in the following part of this lesson.

Why we heat our homes. In the warmer parts of the United States where freezing occurs only occasionally, when there is a frosty night, the heating of homes is a very simple matter. Open fireplaces, stoves for burning gas or kerosene, and electric heaters give sufficient heat for comfort on cool mornings and evenings and on rainy days. Even in such places there are times when people need a little heat for comfort, just as in some other parts of the country we need some heat on cool days in July and August.

There are very large areas in the United States where the winters are severe and health is very much affected by the proper heating of homes, schools and public buildings. In 1920 the population of the United States was nearly 106 millions, and of these more than 70 millions lived in the states in which there are cold winters; and hence the great majority of people in this country are interested in heating systems for comfort and the protection of their health.

Fireplaces and stoves. The earliest heating systems for civilized people in America consisted of big fireplaces for burning wood. They were found in all houses built in the early history of this country. There were then no stoves for heating, but fireplaces and their chimneys were easily built of stones or of crude bricks. When stones and bricks could not be obtained easily, the fireplaces and chimneys of log cabins were built of sticks of wood and then plastered inside with mud so that they would not catch fire.

Fireplaces were used in two ways by the pioneers in America. They were used to heat houses and for cooking food, until about the middle of the nineteenth century, when cooking stoves began to come into use. There are still many cabins in remote regions of this country which use only fireplaces for both heating and cooking.

Fireplaces for heating are still preferred by many people because it is pleasant to watch an open fire. They give good ventilation, and they will burn large pieces of wood which do not require the labor necessary for cutting small pieces to fit stoves. Fireplaces, however, never have been entirely satisfactory and healthful in cold regions, because they do not heat rooms uniformly and they require a large amount of wood. These difficulties led to the invention of stoves for burning wood. One of the earliest of these, the Franklin stove, was invented by Benjamin Franklin. It required much less wood than a fireplace and heated the room more uniformly, which made it less likely that people sitting in the room would take cold. Many other kinds of stoves for burning wood were invented during the nineteenth century, and thousands of them are still made and sold every year in places where there is plenty of wood. In the states where corn is grown and wood is scarce, many of these wood-burning stoves are used for burning corncobs which are often abundant because the corn is shelled before it is shipped. In these states there was always a scarcity of wood for burning in stoves.

When wood became scarce in certain localities and soft coal could be obtained, iron baskets for burning coal were set on the andirons in the fireplaces. As the use of soft coal became more popular, smaller fireplaces with special grates for burning coal were constructed in houses in the regions where soft coal was obtained cheaply. About the same time stoves for burning coal also became popular in many places.

A rapid change from wood to coal for heating houses came during the last century because forest destruction made wood scarce in many places and because coal was easier to transport and store. Why is this so?

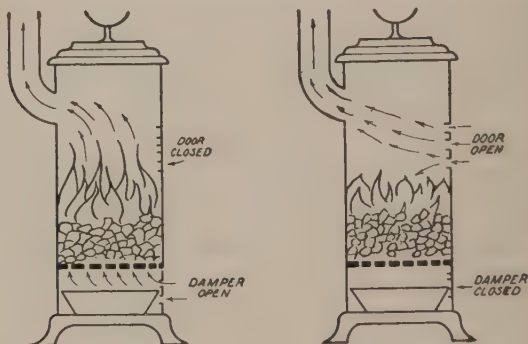


FIG. 58. These pictures show by arrows where the air enters a coal stove. Why does the fire burn faster when the damper is open and the door is closed?

Stoves for coal differ from those for burning wood in that coal must be placed on grates so that the air on its way to the fire will pass through the grates. Notice in Figure 58 the arrows showing the path of air

through the grate. Why does not the coal burn rapidly when air enters only at the door above the coal (see picture at right in Figure 58)? If wood is to be burned in a coal stove, the grate should be covered with sheet iron or a bed of ashes. Why?

The discovery of "hard" or anthracite coal led to the invention of very satisfactory coal stoves which require filling but once or twice a day. These stoves are still very common in villages and cities where anthracite coal may be obtained.

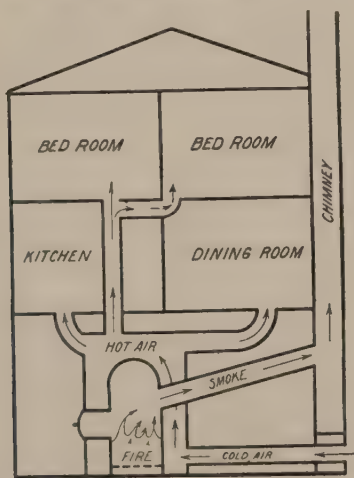


FIG. 59. This hot-air heating system has a pipe to each room. Trace cold air from outside the building to the chamber over the fire where air is heated. From there it "rises" or rather is forced up to the rooms.

Hot-air systems. Stoves for either kind of coal are efficient for heating, but as a rule they heat only

one room for each stove, and the coal and ashes make a large amount of work for those who attend the stoves, and especially for those who have to clean the house. For these reasons, stoves are being replaced wherever possible by hot-air furnaces, which are really big stoves located in the cellar and surrounded by sheet-iron

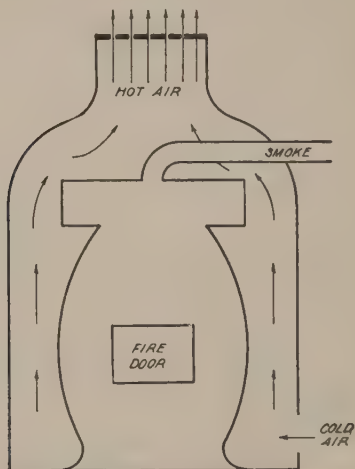


FIG. 60. The "pipeless" furnace from which the hot air "rises" to a single register. This is often located in a hallway. The air enters the furnace from the room in which it is located or a duct may bring air from outdoors, as in Fig. 59.

jackets. They are so constructed that the hot air rises to the rooms above. This method of heating the home reduces very much the work of carrying the coal and ashes and of keeping the house clean.

The chief advantage of hot-air systems is that one fire in the cellar will heat an entire house with many rooms. Before such heaters were invented, an eight-room house often had five or six fireplaces or stoves for heating.

The first hot-air systems had large pipes for conducting heated air up to the rooms, as in Figure 59. This

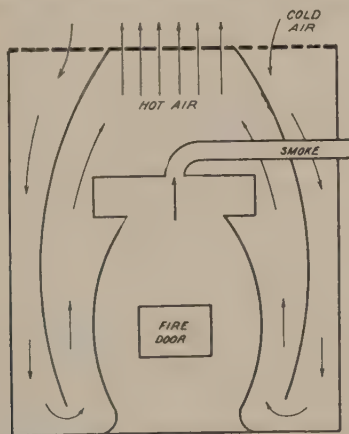


FIG. 61. A "pipeless" furnace to which the colder air from the room returns to be reheated. Notice that the hot air rises in the center of the register.

is still a common system for heating houses and other small buildings. Fifty years ago many large public buildings were heated this way, but now steam and hot water are used for large buildings.

Some furnaces are "pipeless" because the hot air rises through big grates or registers just above the furnace, as in Figure 60. In that figure the cold air

is shown coming from out of doors to the furnace, and after being heated it rises to the room above. In some houses the pipe for cold air leads from the coldest room on the lower floor. Some of the pipeless furnaces take air from outside the house, as shown in Figure 60, and some of them get air from the colder parts of the house, as shown by the arrows in Figure 61.

Both kinds of hot-air heating systems, that is, pipeless heaters and those with pipes leading to the rooms,



FIG. 62. The register used with the furnace shown in Fig. 61. The hot air "rises" in the center, which is shown by heavy lines, and the colder air descends through the openings shown by lighter lines on the outside.

are used for small houses; but most heating engineers say that hot water and steam systems are far better for houses with many rooms, in so far as heating is concerned, because they heat houses more uniformly and use less fuel.

Hot-water systems. The arrangement of a hot-water heating system is shown in Figure 63. The fire heats water in an iron boiler, which is like a steam boiler. The boiler, all the pipes and the radiators must be full of water. A small tank, known as an "expansion tank," must be placed several feet above the highest radiator. This tank may be in the attic if it is warm enough to prevent freezing. The tank should

have very little water in it when the system is filled with cold water, because when the water is hot it will expand and the tank will be almost full. When the

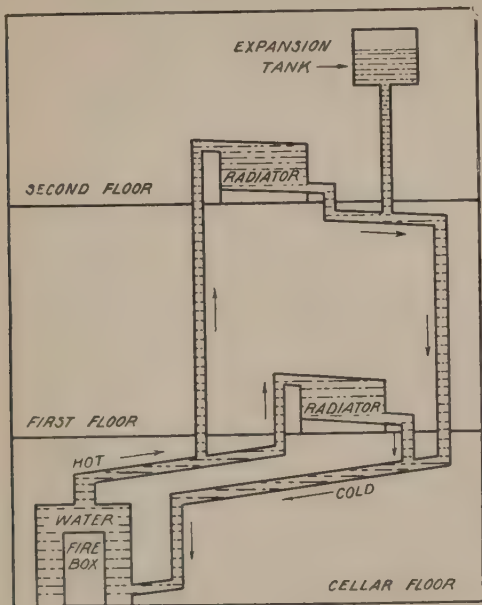


FIG. 63. A hot-water system. Notice that the boilers, pipes, and radiators are full of water. Is this so in Figs. 67 and 68? Trace the hot water from the top of the boiler to the top of each radiator, and the cooled water back to the bottom of the boiler. The expansion tank keeps the system full of water.

water is heated it rises to the top of the boiler and then through the pipes to the top of each radiator. The water cools as the radiators give off heat to the

air of the room, and then the cool water settles to the bottom of the radiators and runs back by way of the return pipes to the bottom of the boiler.

Follow the arrows in the picture, and you will see that the water will circulate in the hot-water heating

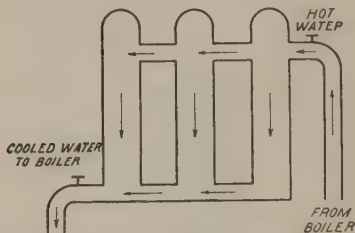


FIG. 64. In hot-water radiators, water coming from the boiler enters near the top and the cooled water leaves by another pipe at the bottom. Why not use a radiator like that in Fig. 66 for hot water? This is the kind of radiator used in such systems as the one shown in Fig. 63. It could be used for low-pressure steam.

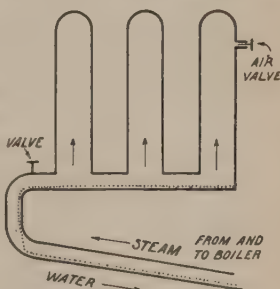
system as long as it is heated in the boiler and cooled in the radiators. Would it circulate if big gas burners kept the radiators in the house as hot as the boilers? Give reasons for your answer.

The hot-water system is the best from the standpoint of heating in cold weather, because it keeps the house uniformly warm; but it is hard to regulate on warm days and in bedrooms at night, because it takes a long time to cool off the large amount of hot water in the pipes and the radiators. Overheated rooms, especially bedrooms, are likely to lead to colds. For this reason, many experts on the proper heating of houses prefer low-pressure steam systems.

What might happen to a hot-water system if the house is closed during cold weather and the air becomes "freezing cold"?

Steam systems. The simplest and cheapest steam system for heating is one arranged like Figure 67 and known as the one-pipe system. The main pipe from the top of the steam boiler in the cellar has

FIG. 65. A one-pipe radiator has only one pipe which conducts steam from the boiler. The dotted line shows where water drains back to the boiler. Look at Fig. 67, which shows how such a radiator should be connected.



branch pipes leading up to the bottom of each radiator. The most important thing to be looked out for by the mechanic who installs such a system is that all pipes and radiators should be inclined toward the boiler, as shown in Figure 67. If they are, all water from condensed steam will run along the bottom of each radiator and the lower sides of the pipes back to the boiler. This is shown by the dotted line in the lower part of the pipes in Figure 65.

In working a one-pipe system, the radiator valves must be kept either tightly closed or wide open. If a little steam is allowed to leak into the radiator, it will condense, and water will collect until the lower part

of the radiator is filled. Then if steam is turned on suddenly, it will cause "pounding" or "hammering" because the water cannot run back to the boiler when the steam is entering. This noise is very disagreeable, and sometimes the "hammering" cracks the radiator. If a valve is known to have been leaking, pounding may be avoided by opening the valve wide and letting

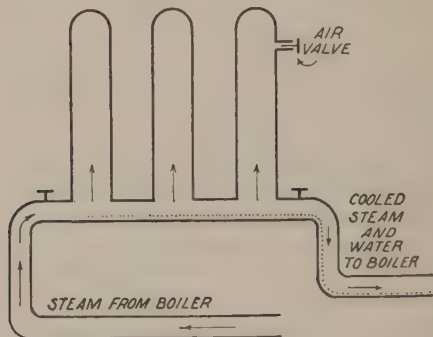


FIG. 66. A two-pipe radiator has one pipe for steam and another to return water to the boiler. Compare with Fig. 65.

the water run back to the boiler, especially before the steam is turned into the main pipes or while the fire is low at night.

The two-pipe steam system has its pipes arranged something like a hot-water system, as you will see if you compare Figure 68 and Figure 63. The steam pipe connects the top of the steam boiler with the radiators and the return water pipe connects the radiators with the bottom of the boiler. The radiator may be like the one in Figure 66, in which the steam

risers and enters at the bottom of the radiator, or the steam may enter at the top of the radiator as in the hot-water radiator shown in Figure 64. Why is the

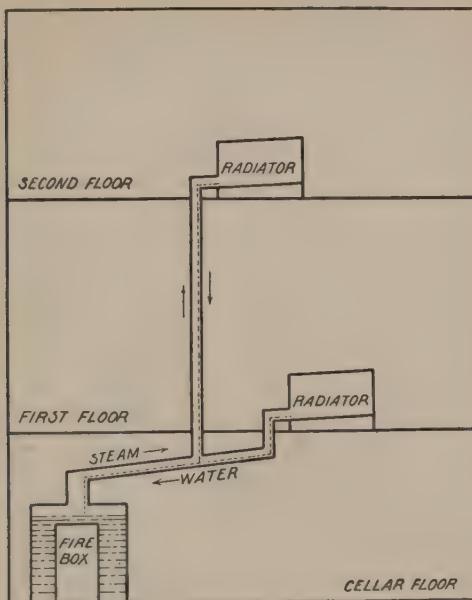


FIG. 67. A one-pipe steam system. Trace the steam from the top of the steam boiler in the cellar to the bottom of the radiators. The dotted line shows where water formed from the condensed steam runs back to the boiler.

steam pipe in Figure 67 connected at the top of the boiler and not at the bottom?

All the steam pipes of a two-pipe system are up-grade from the boiler to the radiators so that the water

from the condensed steam can trickle back to the boiler. All the pipes for returning the water from the radiators must slope downward to the boiler so that

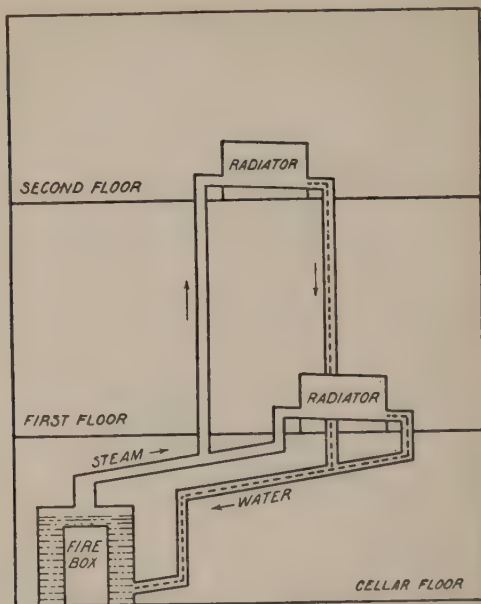


FIG. 68. A two-pipe steam system. Trace the steam from the top of the steam boiler in the cellar to the bottom of the radiator on each floor, and follow the dotted line that marks the path of the water (formed from the condensed steam) returning to the bottom of the boiler.

the water can run from the radiators down to the boiler. Figure 68 shows both sets of pipes inclined. If they are arranged this way, water cannot accumulate at bends and elbows, and therefore there is no pounding, such as occurs when radiators or pipes contain water.

If a radiator of a two-pipe system gets filled with water because a valve has been leaking, the outlet valve should be opened first so that the water can run back towards the boiler before steam is let into the radiator. Sometimes one-pipe or two-pipe radiators pound or hammer because they are not set so that the water can run out properly. The lowest place on the one-pipe radiator should be where the steam enters, while the lowest place on the two-pipe one should be at the outlet pipe. A carpenter's level will show how a radiator stands, and pieces of wood may be placed under the legs so as to adjust it properly.

The use of air valves on steam radiators. In both kinds of steam radiators there must be an air valve for letting out air when the steam is first turned on. On many old radiators we still see hand valves, but automatic valves which will let out air but not steam and water are now placed on practically all new radiators. An exception is found in the case of radiators in big schoolhouses and other public buildings; in these the water from the outlet end of a two-pipe radiator is constantly pumped by a special pump which draws water and air back to the boiler so as to increase the flow of steam. Such radiators do not need air valves and they will become hot in less than half the time required by an ordinary radiator.

You may wonder how radiators like those shown in Figure 65 allow the steam to rise to the top of each vertical section. This will be better understood by trying a simple experiment as follows: Into a shallow

pan put a small quantity of water and place it on a stove or gas burner so that the water will steam quickly. Now take a long tin can, such as some of the long boxes made for crackers or ginger snaps, and place it in the position shown in Figure 69. In the bottom of the can punch a small hole which can easily be plugged by a piece of wood or the sharp end of a lead pencil. If the hole is plugged when the can is inverted over the steaming water, it will take some

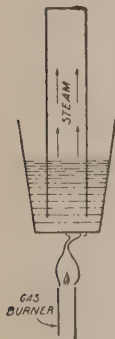


FIG. 69. This experiment, in which steam heats a long round can which is turned upside down in a pan, shows how steam "rises" in radiators like those in Figs. 65 and 66.

time for the steam to fill the can and make it hot, but if you leave the hole open so that the air can escape, the whole can will become heated in a much shorter time. The can represents one of the columns of a steam radiator, of which three columns are shown in Figure 65, and the hole in the can acts in the same way as the air valve which lets air out of the radiator. Of course, steam can easily circulate to all parts of a radiator made like the hot-water one shown in Figure 64

because the columns are connected both at top and bottom.

Heating schoolhouses. Many school buildings with more than two rooms are heated by hot-air furnaces, low-pressure steam or hot-water heaters. Everything which you have learned about the use of such ways of heating houses applies to school buildings. If your schoolhouse is heated by a fire in the cellar, your teacher and the janitor will show your class how heat from the fire downstairs gets up to the schoolroom.

How are the other public buildings, such as churches, town hall, grange hall, court house, etc., in your neighborhood heated? Do they all have the same kind of heating system as your school has? Country schools with one or two rooms are still, as a rule, heated by stoves using wood or coal. Less than a hundred years ago many such schools had fireplaces, but big stoves for heating large rooms have been used in most country schools in America for over seventy years.

The stoves are usually placed near the center of the schoolroom. The result is that the pupils near the stove are too warm and those near the sides of the room are too cold. Both those who are too warm and those who are chilled take colds easily in such a schoolroom.

The same thing may happen when there is a hot-air furnace in the cellar. Those who sit near the "registers" are too warm when those near the windows are comfortable.

The proper temperature for a schoolroom when heated by a stove or furnace is 65° to 68° F. If the temperature is higher, the air feels uncomfortable unless it is stirred by an electric fan or by currents of air from an open window. We can endure a much higher temperature when the air is moving. Did you ever feel hotter on a summer day when the automobile stops after you have been riding rapidly?

Jacketed stoves. Any school which does not have a furnace, hot-water, or steam for heating should

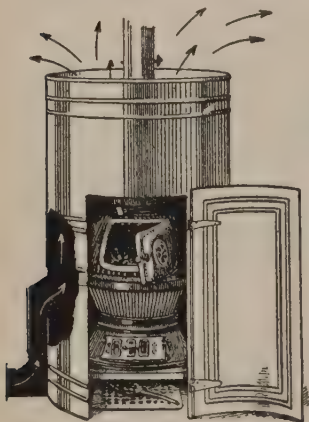


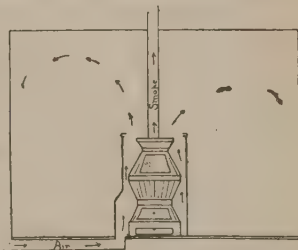
FIG. 70. A metal "jacket" around a stove in a schoolroom prevents pupils who sit near the stove from becoming too warm. Fresh air enters by a pipe from outdoors as shown by the black part at the left of the picture, or from the floor of the room. (After Conn)

have jacketed stoves, as shown in Figure 70. Fresh air comes from outdoors through a tin duct under the floor (Figure 71). If there is no such duct, the colder air will move along the floor of the room to the base of the stove. In either case, the air heated by the stove "rises," as shown by the arrows in Figure 70, and

blows out toward the sides of the room. School laws in some states require such stoves. Are there any special laws about heating schoolrooms in your state?

The jacket may be made of zinc and lined with sheet asbestos; or better, it should have a double wall of galvanized sheet iron or sheet zinc. The walls should be held by bolts so that there will be an air space between them. Very little heat will get through such

FIG. 71. This diagram of a schoolroom with a "jacketed" stove shows how fresh air from outdoors enters through a duct under the floor. The cold air is heated by the stove and circulates through the room.



double walls, and pupils near such a jacketed stove will not be uncomfortably warm when the temperature is what it should be ten to twenty feet away from the stove.

If there is no "jacket" around the stove in your schoolhouse, the boys who are "handy with tools" can make a screen. Use strips of wood 1" x 2" or 1" x 3" to make a square frame five feet high, and tack sheet zinc or galvanized sheet iron on both sides of the frame.

Cold floors. In many country schools the children suffer from cold feet, not because the room is not heated, but because cold air comes through the floor. Cold feet are uncomfortable; they also are likely to

lead to "colds." If there is a basement under the schoolhouse, its doors and windows should be kept closed in cold weather. If there is no basement, all openings in the foundation walls should be closed. Some country schools stand on posts of wood, stone, or brick, and in these cases it is necessary to nail or fasten boards to these posts to form a wall against which dirt may be banked to keep out the cold air.

If you attend a country school, do your feet get cold when you are there? Are your stockings clean and dry when you arrive at school in the morning? Does the floor feel cold? Can you see any holes in the foundation walls through which cold winds can blow under the schoolhouse floor?

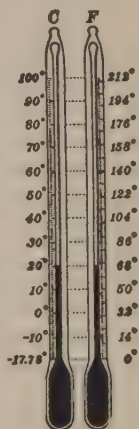
Very dry air is not healthful. The air in most school buildings is too dry. If the air is very dry the room will seem "stuffy," and besides, warm dry air is not good for the membranes in your nose. For these reasons, there should be a kettle of water on the stove, or pans of water on radiators and hot-air openings. Many hot-air furnaces have in them iron pans for water, but most janitors forget to keep them filled. You can watch a pan or kettle if it is in the schoolroom, and make sure it has water for evaporation and moistening the air.

Another good way to keep air moist is to hang up a wet towel and let the lower end dip into water in a pan. When the top of the towel dries, water will rise from the pan, just as kerosene rises in a lamp wick. Thus the towel is kept wet and constantly giving off

moisture to the air. This works especially well if you set the pan so that the towel hangs over a radiator or near a stove. Try such an experiment to see how much water is given off into the air in a day.

In most houses heated by hot air, steam, or hot water, the air is too dry, often as dry as in deserts.

FIG. 72. Most thermometers used in our homes are Fahrenheit. They register 212° at boiling and 32° at freezing; the Centigrade thermometers used in all scientific laboratories register 100° at boiling, and 0° at freezing. Notice that 0° in the F scale is almost 18° (17.78) below on the C scale. The temperature of heated rooms should not be higher than 68° Fahrenheit (F) or 20° Centigrade (C). Look for these in the picture.



Such dry air makes us feel chilly when the thermometer is about 65° F., because dry air causes very rapid evaporation, which cools the skin. If we can increase the humidity by letting in outdoor air or by evaporating water in pans placed on stoves and radiators, we will feel more comfortable at 65° F. with proper humidity than we will at 72 to 75° F. when the air is as dry as in a desert region. The right amount of moisture in the air in our rooms makes them more healthful, and it also saves fuel.

Danger from fire. Millions of dollars' worth of buildings are burned every year and thousands of families are made homeless by fires caused by heating apparatus. Therefore it is important that every one should know how to prevent such fires.

Never leave a "roaring" fire of wood in a stove. It may overheat the pipe and set fire to the house.

Never build a "roaring" fire in a fireplace. The flames rushing up the chimney may get through a crack between the bricks and set fire to wooden parts of the house, or sparks may fall on the house or other buildings and set fire to the roof. Newspapers, oily rags, and dry evergreen branches are especially dangerous when burned in a fireplace.

A fireplace should have a wire screen to prevent sparks from flying into the room. A small fire can be smothered with ashes before you go to bed or leave the house.

No waste paper, wooden boxes, excelsior, kerosene, or other things that burn easily should be kept in a room or cellar where there is a stove or furnace.

Hot ashes should never be placed in wooden boxes or barrels. This is especially true in the case of wood ashes because its "coals" or "embers" easily set fire to dry wood.

Smoke pipes of stoves and furnaces should be securely anchored by wires and iron bands.

Furnace pipes that get very hot should be covered with asbestos, and there should also be a sheet of zinc and air spaces between them and any woodwork.

Watch carefully on very cold days and be sure that stoves and furnaces and their pipes are not heating woodwork so hot that it may take fire.

It is dangerous, for you and for the house, to start a fire by pouring kerosene into a stove or furnace. If this is ever used, it should be poured on pieces of wood and allowed to soak in before the wood is placed in the stove or furnace.

The neglect of one or more of these precautions has caused many fires in houses, schoolhouses and other buildings that have heating apparatus.

How to use what you have learned about heating. You have now learned the essential facts regarding the various systems of heating houses and other buildings in which we live and work and play. You understand their construction and how they work. You have learned a number of rules for more healthful heating of buildings. Of course you have not learned these facts in order to forget them. You are in school to learn what you can use now and after you leave school. Here is a good chance to practice using what you have learned. Keep your eyes open and see how much of what you have learned in this chapter is actually used in heating your home, your schoolhouse, the buildings in your neighborhood, or other places that you may visit.

Everything you have learned about healthful heating of the schoolroom will apply to homes. Are the floors cold at your home? Does the baby get "croup" when he plays on the cold floor? Are there openings where cold winds can blow under your house? Is the air in

the rooms very dry? Do you sit near the stove or radiator until your face is red and you feel "sweaty"?

Heat for cooking. In the colonial days in this country, and even until long after the Revolutionary War, the kitchen of a farmhouse was the only room kept warm, the warmth being supplied by a big fireplace which served for both heating and cooking. This room was not used entirely for preparing food. It was a combined kitchen, living room, nursery, dining room, serving room, spinning room, butter factory, and laundry. In fact, the kitchen was where the members of the family lived, worked, and played most of the time in winter when they were not sleeping in a cold room upstairs. In many of the log cabins of that time even the beds were in the colder part of the only room in the house; but usually the boys who were old enough to climb a ladder through the scuttle hole slept in the attic, which was almost as cold as a barn. If the night was very cold, the mother would probably warm the beds by placing between the blankets a heated soapstone or a "warming pan," which was a covered iron pan filled with hot coals from the fireplace.

The fireplace was the only means of cooking food in the house until about the middle of the nineteenth century, when cooking stoves began to come into use. There were many utensils fitted for cooking at the open fire, and samples of these are now preserved in museums in this country. Some of the fireplaces had in their side walls cavities that were used as ovens.

Cooking stoves or kitchen ranges, made of iron, served for heating the room and cooking food. Even today there are thousands of homes in country districts which never have any fire in the house except in the kitchen stove. It makes a very satisfactory heater because of the large amount of iron surface which gives off heat.

There are now hundreds of styles of cooking stoves, but they are all on one plan, which is shown in Figure 73. The heat from the fire is directed against the flat top, made of cast iron, on which stewing pans, kettles, and griddles are placed. If the top is not hot enough, there are four or more holes with iron lids which may be removed so that the fire may touch the kettles or griddles. If the oven is to be heated for baking, we simply turn a damper so that the hot smoke goes around the oven, as shown by the arrows in Figure 73, before entering the smoke pipe which leads to the chimney.

Perhaps you have heard people say that their cooking stoves do not "draw" when baking. They mean that the fire does not burn well when the damper is turned so that the hot smoke has to go around the oven on its way to the chimney. You know that smoke naturally goes up, but you see in Figure 73 that in going around the oven, smoke must go down. It really must be "drawn" or "sucked" around the oven by a strong draft in the chimney. For this reason cooking stoves require chimneys which have a strong draft, or "draw well." There should be no cracks in

the chimney walls and the top of the chimney should be higher than the house and not overhung by trees. There are certain other things a builder of chimneys may change if the kitchen stove does not have a good draft when the smoke is turned around the oven.

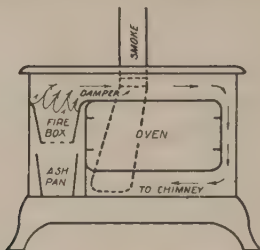


FIG. 73. The arrows indicate the current of hot air when the damper to the smoke pipe is "closed" and the stove is baking. When the damper is open, as when starting the fire, the smoke and much of the hot air goes directly from the fire to the smoke pipe.

If you can, tell what some of them are. Unless a stove has small cracks, or is full of ashes and soot, any trouble with the draft will be found in the chimney. People often waste money buying new cookstoves when they should have the kitchen chimney repaired or the stovepipe cleaned.

Kerosene and gasoline stoves. In most cities gas stoves are commonly used for cooking food. In recent years many kinds of stoves that burn kerosene and gasoline have come into extensive use in the country and in small towns. Some families use these for cooking all the year; and they heat their kitchens, just as they do other rooms, by the heating system in the cellar.

Others use gasoline or kerosene stoves in warm weather, and a cooking stove which burns coal or wood in the cold weather, when they must have heat for comfort as well as for cooking.

Find out what kinds of kerosene or gasoline stoves for cooking are used in your neighborhood and sold at the hardware stores. Notice the kinds of burners on these stoves, and ask people who use them what special rules are necessary in order to avoid danger of explosions. Find out why gasoline stations have the sign "No Smoking Allowed." Why is gasoline not so safe as kerosene for use in a cooking stove?

TOPICS AND SUGGESTIONS FOR TWO-MINUTE TALKS

Choose a topic from the list which begins below.

Find out what this chapter tells about your topic.

Read the suggestions that are given for your topic.

Set the day for the Two-Minute Talks.

Prepare everything you need and plan how you will use it.

See whether you have too much for a two-minute talk, and if necessary decide what to omit.

Give your talk to a friend, and ask for suggestions to improve it.

Write your topic on a slip of paper and hand the slip to the chairman of your class.

Be ready to talk when the chairman announces your topic.

Listen to other talks as if you had nothing else on your mind.

TOPICS

1. Ways of keeping our bodies warm.

Use pictures cut from old magazines to show the two ways mentioned in the first short paragraph of Chapter III.

Then think of other ways. One of them was suggested in Chapter I. Another is suggested by something that Chapter III tells about cows and horses. There are at least two other ways. Find or draw pictures to illustrate all the ways.

2. Kinds of material used for clothing.

The second paragraph in Chapter III is full of ideas on this topic. Get samples of all the materials and show them as you talk. If possible get the raw material and the finished cloth. Refer to some of your own clothing and tell what it is made of.

3. How the skin is affected by heat.

There is a whole section of Chapter III which gives ideas on this topic. Plan and report an experiment, or tell incidents that show how your skin was affected by heat.

4. From primitive to modern ways of heating homes.

You will find most of the ways mentioned in Chapter III. You can make a search through old magazines for pictures to illustrate your talk. Arrange the pictures in a series. Mount them on cards and show them one at a time as you talk.

5. Things used for fuel.

After reading Chapter III you should be able to make quite a list of things used for fuel. Then go to an encyclopedia and see whether you can find other fuels to add to your list. Make a collection of actual fuels or of pictures which show how each is obtained or prepared. Use this as you talk.

6. How a hot-water system works.

Find the diagram in Chapter III that explains this. Study the diagram and what is printed under it. If possible go to a house that has a hot-water system. Make a large diagram and use it for your talk.

7. How a steam-heating system works.

Use the suggestions under topic 6, but adapt them to steam-heating systems.

8. How a hot-air heating system works.

Get ideas from topics 6 and 7.

9. How to keep indoor air moist.

Describe two or three ways. If possible experiment with each way yourself before you decide to talk about it.

10. How to prevent fires in homes.

Your book gives a long list of ways. Make a poster or a slogan of each one. Use these in your talk.

11. Why school heating-stoves should have "jackets."

Find out what Chapter III says on that topic. Then study the two diagrams of such stoves in your book. Enlarge one and use it when you talk.

12. How people kept warm in colonial days.

After you have read what Chapter III says on this topic, you will do well to consult histories and books on colonial life. If you find more than you can tell in two minutes it may be well to have some other person share the topic with you. You should have pictures of the old heaters of colonial times.

13. Kinds of cookstoves.

It should be easy to find pictures to illustrate this talk. Chapter III lists many kinds of cookstoves.

14. How to cook without stoves.

This is a fine topic for a Boy Scout or some one who is interested in camping and primitive cookery.

(Here are four topics for which no suggestions are needed.)

15. How our school is heated.

16. How my house is heated.

17. How our cookstove works.

18. Kinds of fuel which our family uses.

CHAPTER IV

HEALTHFUL CHANGES OF AIR IN OUR BUILDINGS

Our buildings need ventilation. If we lived or worked in rude tents or huts in a warm country we would not have to think about how to ventilate them. Most of our houses, schools, churches and factories in the United States are inclosed by walls, doors, and windows so that the air in them is not easily exchanged for fresh air from outdoors. Therefore, we have to give special attention to changing or renewing the air in our buildings. This is what we mean by "ventilation."

This word "ventilation" came from an old Latin one that meant "wind," and some people still think that in order to ventilate a room we must open doors and windows so wide that the wind can blow fiercely through the house. This is not true at all. We can have good ventilation by such gentle currents that feathers lying around the room are not moved. In fact, slow currents of air are better because they do not stir up dust which might get into our lungs, and because many people take cold when they sit in strong drafts of air. There are times when we need to open doors and windows wide and cause a sudden

change of air, but at such times we should not sit still and get chilled. For example, if the schoolroom needs a thorough airing, the teacher should have the pupils stand up and exercise while the doors and windows are open.

Why ventilation is necessary. Closed and artificially heated rooms, in which we live and work in winter,

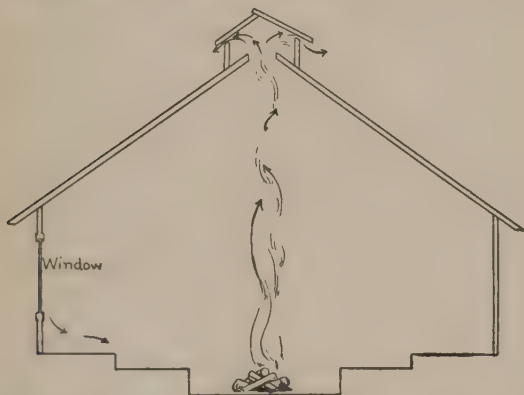


FIG. 74. This Indian house, which was sketched in Alaska, a few years ago, had a pit in the center for the fire; around that was a higher floor on which the Indians sat, worked and played. They slept on the highest part of the floor. The arrows show how such a house is ventilated.

require a frequent or constant supply of fresh air. When many people stay a long time in a room, they may not notice that the air is slowly becoming "stale"; but if they go out of doors into the fresh air and then come back into the room, they will notice that the air seems "close" or "stuffy" and has a disagreeable odor. Did you ever notice such an odor when

you returned to the schoolroom after the lunch hour or after recess?

The changes which take place in the air in a closed room in which people live and work are as follows: the air usually becomes more heated, it has more moisture, it loses oxygen, it has more carbon dioxide and it has small particles which cause odors.

Changes in air caused by breathing. When air is inhaled or breathed into our lungs and then exhaled or breathed out, the chemists find that some oxygen has been taken out of the air and some carbon dioxide has been added while the air was in the lungs. The reason for this is that the blood circulating through the lungs absorbs from the air-chambers of the lungs some oxygen needed in all parts of the body, and at the same time the blood gives up some carbon dioxide to the air.

While the air in the lungs is giving up some oxygen and receiving some carbon dioxide, it is also receiving some heat and moisture from the blood in the lungs.

There are five changes in the air breathed into the lungs: (1) it loses some oxygen, (2) it gains some carbon dioxide, (3) it gains some heat, (4) it gains some moisture (water), (5) it gains small particles which may cause odor in the air.

The first change of air in the lungs cannot be shown by any simple experiment, but chemists prove it by special apparatus. The second is shown by breathing through a straw into limewater which is turned milky by carbon dioxide. The third may be shown by breath-

ing on a thermometer and comparing the temperature with that of the air in the room, provided the temperature of the air is not higher than that of your body. The fourth is evident when we breathe on cold window glass. The fifth can be detected by chemists. ("Bad breath" is commonly caused by indigestion, or diseased tissues in the nose, throat, etc.)

These five changes in air are reasons why we should have fresh air in rooms. The third, fourth, and fifth are most important.

Effect of oxygen and carbon dioxide. It is a popular belief that if many people were shut in a closed room they would rapidly use up the oxygen and be poisoned by carbon dioxide given off by their lungs. You may have read in your history that during a rebellion of the Hindoos some British soldiers were captured and thrown into the "Black Hole of Calcutta" in which most of them died before morning. It was long supposed that the unfortunate soldiers had used up the oxygen and were poisoned by carbon dioxide. It is now known by physiologists that the men were not killed by lack of oxygen or poisoning by carbon dioxide, but by the great heat and moisture of the air which slowed the action of their skins in reducing the inside temperature of the body. In other words, too much internal heat killed the soldiers.

No room in any building has been found which did not have plenty of oxygen, as it could be kept out only by air-tight walls, windows, and doors.

Carbon dioxide is not a poison and does no harm

except as it displaces oxygen which we need for breathing. This sometimes happens in deep wells, but there is never enough carbon dioxide in rooms, homes, schools, or churches to have any serious effect on our supply of oxygen.

It is now believed by scientists who have investigated this question that we do not need to ventilate

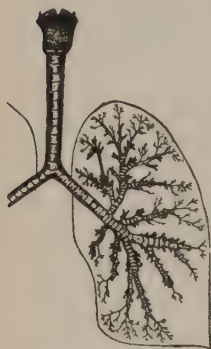


FIG. 75. When air is breathed in, it passes through the nose or mouth to the pharynx, larynx, and trachea, or windpipe, to the lungs. The windpipe branches to each lung, in which there are hundreds of smaller branches. (After Colton)

in order to let in more oxygen or let out some carbon dioxide. There are more important reasons for ventilation, namely, to keep the temperature comfortable and to keep down moisture. Both of these affect the effort of the skin to regulate our internal heat.

Effects of heat and moisture. Experiments on ventilating have been made with students and others who have volunteered to work in small, air-tight rooms into which air could enter only when forced by an air pump. Careful measurement of the oxygen

used and the carbon dioxide formed in such a room has been made by chemists. It has been found that the first signs of discomfort are due to heat and moisture. If the air is very dry, students in such experimental rooms can stand much more heat than when it is moist. Moreover, they can stand more heat and moisture if the air is kept moving, as by an electric fan.

You know that the most uncomfortable days in summer are those when the air has high humidity, that is, much moisture. We usually can feel whether the air is very humid or "heavy." On such days cold water pipes often "sweat" or condense moisture from the air, and clothes do not dry well. We know that on a day when such things indicate high humidity, a temperature between 85° and 90° F. is more uncomfortable than even 95° F. would be on a day when the air is dry.

On warm, humid days when we feel very uncomfortable, "sunstroke" or "heat prostration" is most likely to occur, because the skin does not get rid of the heat inside of the body as rapidly as it should.

How the skin is affected by heat. One important use of the skin is that of protecting the body. Another is that of regulating the internal heat of the body. Food that has been digested and distributed by the blood to all the tissues of the body is constantly, but slowly, being burned and producing heat. Our living cells in all parts of our body are accustomed to an internal temperature of about 98° F., as shown by a thermometer held in the mouth under the tongue.

When we are very ill the temperature rises, and we have fever; and if it goes up to 105° F. or a little more, the doctor says we are seriously ill.

The fact is that the living matter in the tissues of our bodies is healthy only when the internal heat is kept close to 98° F. It is the business of the skin to

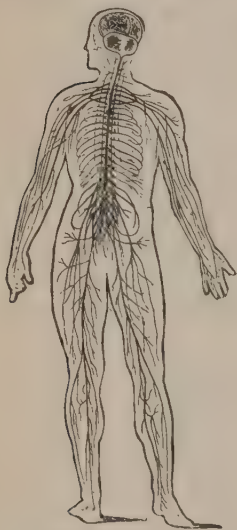


FIG. 76. The regulation of the internal heat of the body depends upon the control of the circulation of the blood in the skin. This control, as well as that of all other functions or activities of the body, is one work of the nervous system. This system consists of the brain in the skull, the spinal cord in the backbone, and the nerves from these organs to every other organ in the body.

look after this and keep the heat in our bodies just as near the proper temperature as possible. If we exercise rapidly, there is more heat inside and the skin must let it out. If the air is cold, the skin must keep in or conserve heat.

The regulation of the heat of the body is done by the nervous system controlling the amount of blood

circulating in the skin. If the skin is cold, it contains little blood; if it is warm and red, its blood supply has been increased. How the amount of blood in any organ such as the skin is controlled you will learn in physiology in high school or college.

The internal heat of the body is regulated in part by the sweat glands, which are abundant over the whole skin. They are closest together on the palms of the hands and soles of the feet, which have no hairs. The "pores" or openings of the sweat glands can be seen with a hand lens. From each pore a small tube extends down into the skin to the small blood vessels which furnish the water and salt, which are the principal parts of sweat.

Sweat is secreted for the purpose of taking the heat from the blood. Everything in sweat could be removed by the kidneys, but these organs could not control the heat of the human body. Dogs have few sweat glands except on the pads of the feet. They pant when they are too warm and then they give off the heat of their bodies from the surface of the tongue and the lining of the mouth.

Our sweat glands cover the skin with sweat which, when it evaporates, cools the blood in the skin. On humid days, when it does not evaporate rapidly, we feel uncomfortable because we are getting warmer than 98° F. A fan cools us because it causes rapid removal of the sweat and heat from the skin. Warm, moist air is less comfortable than warm dry air, for dry air takes up the sweat rapidly and cools the body.

The cooling effect of evaporating water may be shown in several ways. Boys and girls in the Western and Southwestern States are familiar with canvas water bags. The Indians made porous water jugs of unglazed clay. Water oozes very slowly through the pores of these bags or jugs, and if they are hung where a hot and dry wind touches them, the evaporating water

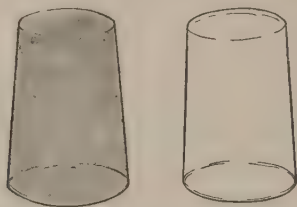


FIG. 77. If you breathe into a cold glass the moisture will show as in the left picture; when you move the glass into a warmer room the moisture will disappear because warm air can take up more moisture than cold air.

carries off the heat and cools the water. Bottles filled with water and wrapped with wet towels may be cooled in the same way. A sponge bath on a hot day, even if the water is 98° F., is followed by cooling of the skin, because the warm water evaporates rapidly and carries off heat from the skin.

You now see why hot and humid air in rooms makes us feel uncomfortable. It is because the skin does not cool fast enough and our internal temperature is slowly rising above the healthful point, about 98° F.

Summary of reasons of ventilation. The chief reasons for ventilation of our buildings are as follows:

To lower the temperature, if the heater makes the air warmer than 65° to 68° F.

To let out moist air, if it feels "close" when the temperature is right.

To let in moist outside air, if a furnace or steam radiator makes the air in a room too dry for the membranes of the nose and breathing organs.

To let out air with particles of dust that carry bacteria.

To let out disagreeable odors.

To get the feeling of comfort and good health that we get best when out of doors.

In short, ventilation is for the purpose of helping us live many hours a day indoors with air just as much as possible like outdoor air, with heat added, if necessary.

How to know whether a room needs ventilating.

First, does the room feel uncomfortably "close"? If so, let in fresh air for a short time until the air feels comfortable.

Second, the air may be too warm. The most accurate way to decide this, is to see whether the thermometer registers more than 65° to 68° F.

Third, the air may be too moist. There are instruments for indicating moisture, but as a rule we have to depend upon our feeling that the air is oppressive. Sometimes steamy or frosty windows indicate that there is too much moisture in the room.

Fourth, sometimes we can decide whether a room is being properly ventilated if we go out into the fresh

air, take several deep breaths through the nose, and return to the room. If the air "smells stale," open the windows and doors so as to let fresh air in and stale air out. A rush of fresh air for a few minutes will be very stimulating to us.

As a general plan for everyday use, the rooms in a home should be well "aired" by wide-open windows and doors while the rooms are being cleaned in the morning and at any other time when this is possible. In cold weather one room at a time can be "aired" and the person who is sweeping, making beds, etc., can keep comfortable with a cap and warm clothing, such as a sweater. Schoolrooms and churches should be "aired" before and after they are used by many persons. The janitor should open windows and doors for a short time, even in cold weather, about an hour before he begins to heat the rooms. If he would always "air" the church both before and after services and never let the temperature rise above 65° F. in weather when fire is necessary, the air would not smell so "stuffy" when we enter from the fresh outside air on Sunday morning.

When several persons in a room appear to be drowsy, it is probable that the air is too warm or too moist, and it is time to ventilate. Teachers know that this is a warning that the air of their schoolrooms is not in the most healthful condition.

Ventilation and heating. In order to heat buildings in cold weather, it is necessary to close the doors and windows and keep out drafts and cold air. This

makes the problem of ventilation much more difficult in winter. Many school buildings which do not require any special attention to ventilation in the summer have very close and stale air much of the time during the winter.

The ventilation of a home or school depends in part upon the kind of heating apparatus used. A fire in a fireplace causes a strong draft up the chimney and fresh air comes into the room through every crack around the doors and windows. We never feel that air is "close" in a room heated by a fireplace. In fact many of them draw out too much air. The fireplaces commonly used about one hundred years ago had very large chimneys, and they drew so much cold air into the room that the only comfortable place was just in front of the fire. At the present time builders make the "throat" and flue of the chimney smaller than the old ones were. We now see fireplaces four feet wide with a chimney whose flue is only one foot square, but in some of the old houses the chimney had flues five or six times as large. Dampers are now placed in chimneys just above the fireplace to regulate the amount of air which goes up. This prevents a waste of warm air at times when the rooms do not need any special ventilation, and at the same time it prevents heavy drafts of air from coming in around the doors and windows.

Next in importance to the use of fireplaces for ventilating rooms are stoves, see Figure 58. The amount of air which can go through a stovepipe is

not always enough for a large room. Country school-rooms with twenty to forty pupils in one room are often badly ventilated because the pipe of the stove does not carry off sufficient air. In such cases ventilating by adjusting the windows as in Figure 78 is necessary.

If a furnace or a jacketed stove, like those in Figures 70 and 71, is used, there will be a constant supply of fresh air from outdoors; but unless there is a fire-place or open windows, there is no outlet for the stale air in a room which has such ways of heating. We often notice that the air is very close in schools and churches that are heated by hot-air furnaces. These furnaces draw in enough fresh air from outdoors, but the air in the room may seem stale because there are little particles of dust and odors that have come from bad breath, soiled clothing, and unwashed bodies. Only a rapid change of air would be sufficient in such cases to make it healthful.

Sometimes it may happen that the only way to avoid bad odors in the air of a schoolroom is to send some of the dirty boys and girls home with a note asking their mothers to give them a bath before they are sent back to school. Have you ever noticed how disagreeable the air is in a crowded street car in which there are several dirty people? Ventilation cannot take care of so much bad air; and even when there are open cars in summer, we do not like to sit near dirty people. We should remember, however, that some of the odors in the air of public buildings, like

schoolrooms, are due to small particles thrown off in the breath. Even if all the people in the room are clean in their personal habits, good ventilation is not sufficient to remove all odors which might arise from this source.

The most difficult rooms to ventilate are those heated by steam or hot water. (See Chapter III.)

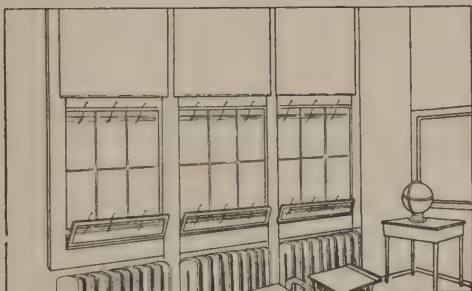


FIG. 78. This shows a good way of ventilating schoolrooms. The windows are so adjusted that they let in plenty of fresh air without causing drafts, and there are enough radiators to warm all the cold air coming into the room.

Such heating systems do not bring in air from outside, as do hot-air furnaces; and, also, they do not take any out, as do fireplaces and stoves. The only way that steam or hot-water radiators affect the air of a room is in heating it, often too much; and they also produce air currents around the room. Did you ever notice that the wall and ceiling above a steam radiator become very dirty? This is due to dust particles in the air which rise from the floor and then ascend to the ceiling above the radiator. Hold a

smoking joss-stick (or a piece of burning strawboard) above a hot radiator and notice the direction of the air currents. These air currents carry heat to all parts of the room and make you feel more comfortable than if the air of the room were standing still, but the same air moves around and around the room, unless fresh air is let in through a door, a window, or a crack.

Many schools, churches, and public buildings that are heated by steam or hot water have registers to let fresh air in near the floor and stale air out near the ceiling. Sometimes these registers are connected with tall flues that act like chimneys and sometimes there are powerful fans in the basement which force in fresh air and draw out the stale air. Did you ever see little flags or ribbons fluttering at the registers where air is being forced into a room? What do you think is the use of such ribbons? How would they help the janitor in his work of keeping the room ventilated?

Ventilation of wells and silos. Every once in a while we read in the newspapers that several persons have been suffocated by going down into wells, mine shafts, or closed silos, where there is so much carbon dioxide that not enough oxygen is left for breathing. Such accidents used to happen frequently in mine shafts, but now mine owners are better informed and take care to prevent such occurrences.

It is never safe to go down into an old well or a deep silo without testing it. Tie a cord to a kerosene

lantern or a candle and lower it to the bottom. If the flame continues to burn brightly, there is no danger.



FIG. 79. These pictures illustrate the most used method of causing artificial breathing or respiration in a person who has been "drowned" or suffocated by gas. The aim is to force fresh air into the lungs and the stale air out until natural breathing starts again. The chest wall acts like the bulb of a rubber atomizer. When you squeeze it, air is forced out of the lungs; when you relax the chest wall, it returns to its original shape and draws in air.

If you are the operator, kneel astride the patient, as in the picture, or at one side, and place your hands on the short ribs across the small of the patient's back with thumbs near together, as in upper picture. Then press as hard as you can in the position shown in the lower figure. This forces air out of the lungs. Then suddenly stop the pressure and swing your own body back to first position (upper picture). This allows the chest to expand and draw in fresh air. Repeat the pressure slowly and steadily 12 to 14 times a minute. Remember that such artificial breathing may save a life if kept up steadily for one or two hours. In every case, however, get a doctor as soon as possible.

If it goes out, the well or silo must be ventilated by blowing fresh air down. Some ensilage cutters blow the chipped cornstalks into the silo, and such "blowers"

can soon force enough fresh air to the bottom. It is safest to start the blower before men enter a deep silo which is being filled, because fresh silage makes much carbon dioxide which may accumulate sufficiently to take the place of the oxygen necessary for breathing.

Ventilation of garages. Many deaths occur in the United States every year because people forget or

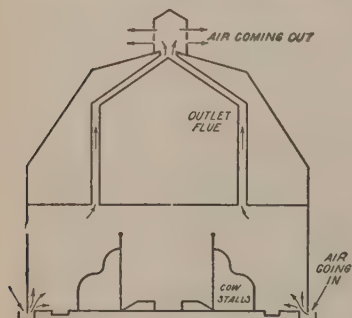


FIG. 80. If cows are to produce good milk, they must have fresh air. This picture shows one kind of ventilating system for cow barns.

have never heard that it is dangerous to run a gasoline motor in a closed room, unless the exhaust pipe leads the waste gases to the outside. Most of these accidents occur with automobiles, but some have been caused by stationary gas or gasoline engines.

The cause of these deaths is not absence of oxygen, but the production in the engine of a deadly gas, called carbon monoxide, because the gasoline is not completely burned into carbon dioxide. Stoves form some of this gas, and when the pipe dampers are closed tightly it may escape into the room and poison persons sleeping there. Therefore, pipe dampers should

never be entirely closed. One should never run the motor of an automobile in a closed room. If it must be tested, open doors and windows first. Never work under a running automobile near the exhaust pipe. Even a small quantity of carbon monoxide is harmful if breathed into the lungs, because it will be absorbed by the blood and will interfere with the carrying of oxygen by the red corpuscles.

Farm animals need ventilation. It has been found that in order to keep cows healthy and in the best



FIG. 81. If pure milk is to be produced, the cow barns should be clean, airy and well lighted. Notice the windows, the clean cement floor, the gutters and the ventilators. (*Photograph by Beals. Courtesy of Board of Health of New York City*)

condition for producing pure milk, cow barns must be well ventilated, especially in cold weather when the doors and windows must be closed. If you have been in the country where there are modern dairy farms, you must have noticed large ventilators, often called cu-

polas, on the tops of barns. These are usually connected with large tubes, made of wood or metal, which lead up to them from the cow stable on the first floor or in the basement. The arrows near the floor in Figure 8o show where the cold air from outside enters. This air is warmed by the heat given off by the cows and then rises to the ceiling where it enters a tube or flue leading to the ventilator on the roof. Each flue acts like a chimney in which the warm air is forced up by the heavier cold air from outside, or as we say "rises".

Many farmers who have old-fashioned barns have no way to ventilate them. They keep their cows in stables where there is no circulation of air, and on a cold winter morning the air is often too warm, has too much moisture, which has come from the breath of the cows, and has an odor which is sickening to one who enters from outdoors. Cows living in such places are more liable to colds, tuberculosis, and other diseases. It has been found that good ventilation helps to keep horses, pigs, and chickens healthy, as well as man.

"WHY" QUESTIONS

Give your answer. Prove by experiment or show by reference to the chapter that your answer is right.

1. Why do tent-dwelling Arabs pay no attention to ventilation?
2. Why must *we* change the air in our buildings?
3. Why should we plan carefully before ventilating a room in which there are people?

4. Why should we let fresh air into rooms in which people have been breathing? Give five reasons:

- a. Air has lost
- b. Air has gained
- c. Air has become
- d. Air has absorbed
- e. Air has gained

5. Why are there more "sunstrokes" on warm humid days?

6. Why is our skin so important?

7. Why could we not stay well if our skin were changed into a dog's skin?

8. Why is a temperature of 101° F. a sign of illness?

9. Why is it healthful to sweat freely when working hard?

10. Why should we have thermometers in homes and schools?

11. Why is the ventilating system in your school good or bad? Make a chart or picture to show why.

12. Why is the air near the floor cooler than at the ceiling?

13. Why does a room with a fireplace usually need no other means of ventilation?

14. Why is it more difficult to ventilate rooms heated by hot water or steam than by hot air?

15. Why is it easier to ventilate a room when every one in it has had his daily bath?

16. Why is it dangerous to run a motor in an enclosed place?

17. Why should barns be ventilated?

TRUE OR FALSE

Select the true statements. Be able to defend your choice.
The main reason for changing the air of a room is the presence
of warmth and moisture

of carbon dioxide

The soldiers in the "Black Hole of Calcutta" died because of
lack of oxygen
internal heat

Internal heat of the body is regulated by the
lungs
clothing
skin

Fresh air is brought into a room by
fireplaces
hot-water heaters
stoves
hot-air furnaces

HOW CAN YOU TELL

How can you tell
which way air is moving?
when to open windows and ventilate?
whether your home needs different ventilation? Study the
heating arrangements, the movement of air due to the
construction of the house, present ways of ventilating.

WHAT SHOULD YOU DO

What should you do
to ventilate a room without having a direct draft on the
people in it?
when the air in a room smells stale?
when the air in a room is too dry?
if you smell gas fumes in a room heated by a stove?
when a person has been overcome by gas fumes?
to find out whether it is safe to go into a deep well or silo?
if you work under an automobile near the exhaust pipe?
to resuscitate a person who has been overcome by gas?

THINGS TO LOOK UP

Find out
what you should do if a person has a "sunstroke."
how a Korean house is heated.
how a Chinese house is heated.
how a Japanese house is heated.

CHAPTER V

HEALTHY LIVING AND LIGHT

Sunlight. Sunlight is necessary for health, to make our homes and other buildings pleasant and attractive, and to enable us to see what we are doing. Many of you may have picked up a board, a box, or



FIG. 82. This child lives in a great city. He has no place to play except the street and this dark stairway. All children should have sunny, attractive places to play, because sunlight and exercise are both necessary for good health. (*Courtesy of Henry Street Settlement*)

some other large object which had been left for a time on growing grass, and have found the grass, which was covered, white or yellowish, and very weak. In cases where small plants, such as grass, are left covered for

a long time, the plants, on being uncovered, will be found dead. Like plants, children who have been kept too much in the house, away from the sunlight, by persons who do not realize their need for it, become pale and sickly. You have all noticed, no doubt, how much paler even older persons look, when they have been confined to a bedroom by a long illness. Did you ever notice how well children are apt to be if they spend much time in the sunlight?

It is true, of course, that the paleness and sickliness of children kept too much in the house are partly due to their not getting such good air and exercise as do

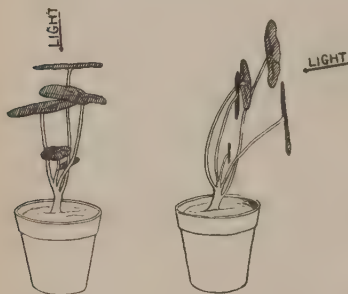


FIG. 83. Cover up the word "light" and see if your father can tell you from which direction sunlight has been shining on each of these plants.

the children who run and play out of doors. It is true also that children who miss the outdoor air and exercise do not have so good a circulation of the blood to all parts of the body, and because of this they usually lack healthy, normal appetites. Nevertheless, scientists have proved that a great deal of the paleness and sickliness is due to the lack of sunlight.

We usually think of sunlight as white or yellowish

white in color, but it really has in it many colors, as you may have seen when a ray of sunlight has been broken into its parts in a rainbow or by a prism, the beveled edges of a mirror, the cut edges of fancy glass bowls, or the glass trimmings of chandeliers. If you will hold a glass prism where it may catch a ray of light, you will see a number of different colors.

When you study physics in high school or college you will learn that what we commonly call "colors" of the spectrum is really the effect upon our eyes of various rays of light. That is to say, red color is one

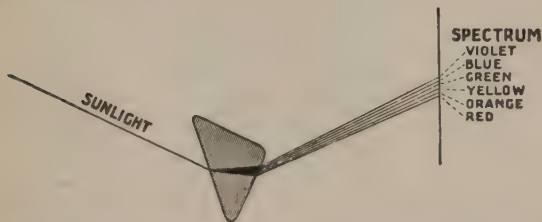


FIG. 84. Sunlight passed through a glass prism shows several colors. Between the violet and blue is a shade of dark blue which is often called "indigo," making a total of seven.

kind of light rays and blue is another, and so on for all the colors of the spectrum.

The violet and blue rays of light are the ones most stimulating to us and to plants. Scientists have proved that there are light rays which we cannot see with our natural eyes; and that those which are just beyond the visible violet rays are very helpful in the growth of both plants and animals. These invisible

rays are called "ultra-violet," which means "beyond the violet rays" that the eye can see.

Use of light for curing disease. There are now electrical machines which are used for making the powerful ultra-violet rays. Doctors often use these violet rays in treating diseased joints, or other diseased places on which they do not dare to operate or which are too deep in the body for ordinary light to penetrate.

There are more of the invisible violet rays of the sunlight to be found in some places than in others. They have difficulty in getting through many substances, even common window glass. There are, therefore, few of these stimulating, helpful rays in our houses, no matter how many windows there may be. Even clothing interferes to some extent with the passage of these rays. Children who have tuberculosis are sent to "tuberculosis" farms where they play and work outdoors most of the time, dressed in very little clothing indeed. Children who have disease of the bones known as "rickets" may be benefited or even cured by sunlight. Rickets is usually caused by improper food; but it has been found very recently that even when the food has not enough vitamins the disease can be checked or even cured by keeping children in the sunlight much of the time. Lamps which give ultra-violet rays are used by physicians in treating children and invalids when sufficient outdoor sunlight is lacking.

Sunlight kills bacteria. Sunlight helps keep us well in another way; it kills many of the bacteria which might otherwise enter our bodies and make us ill.

Many harmful bacteria are constantly getting into the air from the noses and the mouths of persons who have colds, sore throats, tuberculosis, and other diseases of this kind. Most of these bacteria die off very quickly in air that is dry. Sunlight, too, helps kill them, as the following experiment shows.

Gelatine was melted, and bacteria were mixed with it; and then the mixture was poured into this little

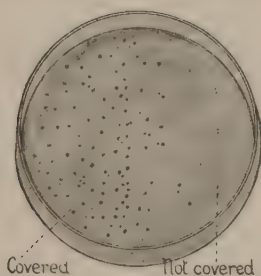


FIG. 85. This dish was filled with gelatine mixed with bacteria. Half of it was covered with cardboard while the sun shone for two hours on the other half, killing most of the bacteria in it.

dish and allowed to become solid again. The left half of the dish was covered with a piece of heavy cardboard to keep out the light. The dish was left in strong sunlight for two hours and was then put into a warm place to see whether bacteria were still alive on each half of it. The spots show where the bacteria were not killed and had grown into tiny masses large enough to be seen. On which half are there the more bacteria? Did the sunlight kill any bacteria? The blue and ultra-violet rays of sunlight are the ones that kill bacteria.

What happens when we expose blankets, pillows, etc., to outdoor air and sunlight? Why should we keep windows and doors open as far as possible?

It is plain, therefore, that our houses should have sunlight, not only in the rooms in which we live but also in those where we go occasionally, like the hallways. Dark corners may hold dust in which bacteria may live for a long time. Cellars and other places where food is kept will be less likely to smell moldy if they have plenty of light. We have to depend upon the cold to keep bacteria and molds from growing rapidly in ice boxes and refrigerators, which are made of materials which keep out light as well as heat.

The present practice of changing porches into "sun-parlors" or living rooms is usually a good one. In the winter time, when less time is spent out of doors, the members of the family often stay for a large part of each day in this cheerful, sunny room, which is more healthful for them than staying in the darker rooms of the house.

Sleeping porches usually allow more sunlight and fresh air to get into them than ordinary bedrooms, and they are therefore more healthful than bedrooms.

Laws control lighting of buildings. Many of our large towns and cities have laws regarding the lighting of buildings. Some laws regulate the amount of window space and artificial light in schools, workshops, and factories, so as to reduce eyestrain. Other laws encourage the use of daylight hours rather than those in which artificial light must be used, for no other

light is so healthful as daylight. There are still other laws which require that cellars, basements, halls and stairways be well lighted. If it is not possible to light these sufficiently with windows, artificial light must be supplied. What accidents may happen if there is dim light in such places?

Is there any law in your town to regulate the lighting of buildings? Is there any building not properly lighted to which you need go?

Artificial lighting of buildings. Since most people sleep only eight to ten hours out of twenty-four, there are left each day from fourteen to sixteen hours for work, reading and play. In summer time in the United States there are about sixteen hours of daylight, if we get up with the sun; but in winter we must have artificial light if we are going to work or read early in the morning or late in the evening. Could your family do without artificial light?

The first artificial light was, no doubt, the camp fire of primitive people. Later, torches made of bundles of twigs, stems or bark of trees and other plants came into use. Hickory barks were often collected for this purpose by early settlers in America. Such simple torches were improved when bundles of bark and other materials were dipped in fat obtained from animals. At a still later time some one discovered that if one end of a bundle of fibers is placed in a dish of grease or fish oil and the other end lighted (Figure 86), the oil will be soaked up by the fibers and both will burn as long as they last. Such grease lamps were the

only ones available when the first settlers came to this country.

One objection to the old grease lamps was that animal fat which would stay liquid was not always easy to obtain before whale oil became available; and so candles made of solid fat or tallow were invented. The first candles were probably made by dipping the



FIG. 86. These are pictures of grease lamps, about three inches long, which were made of sun-baked clay. The one at the left was made in Babylonia more than 6000 years ago. Later lamps were cut from soft stone or made of metal.

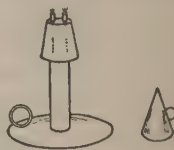


FIG. 87. This is a picture of a whale-oil lamp said to have been used by Abraham Lincoln in his first law office. The tin cap, shown at the right, was used to put out the flame of such lamps.

dry stems of rushes (a kind of plant) into melted tallow, such as we get from beef or mutton. The first dipping covered the stem with tallow which soon cooled and hardened. Then it was dipped again into tallow and again allowed to cool. This was repeated until the candle was about one inch in diameter. Later, when cotton strings could be obtained, they were used for wicks instead of the stems of the rushes. Such cotton wicks are still sold under the name "candle

wicking." Tin or lead molds for casting candles without dipping have been used for a long time in America.

Candles are still used in many homes, and millions of them are made by machinery every year. Probably most of them are now used chiefly for decoration, but some homes far from towns and cities have no other source of light.

The whale-oil lamp came before the modern kerosene lamp, but it soon went out of use after kerosene was discovered. These lamps were of many styles, but all were simply vessels containing oil into which dipped a wick made of twisted cotton fibers. The wick was drawn through a tube on the edge of the vessel, and this prevented fire from getting down into the oil. The old whale-oil lamp would now be considered a very poor lamp indeed, but there was a time, many years ago, when such lamps were thought to be very wonderful. Like candles, such lamps gave out a great deal of smoke and odor. Besides, their flames flickered a great deal, and this flickering tired the eyes.

The first kerosene lamps had no glass chimneys and they were little better than the old whale-oil lamps. When chimneys were added, the flame burned much more steadily; it was much brighter, and there was little smoke. This is partly because the supply of oxygen from the air is greater. Figure 88 shows how the current of air passes in through the burner which holds the wick, and out through the top of the chimney.

Gas is usually either natural gas, obtained from

wells sunk in the earth, or manufactured gas, obtained from coal. Gas is piped into our houses, and then burners are placed where we need light — near a stove, over a table, on a stairway, etc. Gas light flickers a great deal, unless it is protected by a chimney or globe made of glass or isinglass, to protect the flame from strong currents of air. These chimneys or globes are made so as to allow the air with its oxygen to go up .



FIG. 88. Notice the arrows which show where air enters the chimney through the holes in the base of the burner, passes up around the flame and then out of the glass chimney. The light from a lamp such as this goes directly to the page of a book or other object and from there it goes to the eyes. This kind of lighting is called direct because light falls directly upon objects.

and around the flame, and then to pass out of the top of the chimney, just as in lamp chimneys. There are several special burners made for gas; some of them spread the flame, and others have "mantles" made of a substance which becomes so hot that it gives a brilliant white light.

All of these ways of obtaining artificial light from burning candles, oil, or gas, affect the air. The burning takes oxygen out of the air, and adds carbon

dioxide, and also a sooty material if there are any unburned parts. When these burning substances are not completely burned, odors are noticed, as in a smoking lamp.

Electric lights do not affect the air as gas and oil lights do, because electric lights do not need oxygen, and do not give carbon dioxide out to the air.



FIG. 89. Three kinds of globes for use with electric bulbs. *A* and *B* are usually made of white glass which lets through some light but reflects more. *A* reflects most of the light to the ceiling and indirectly down (see Fig. 90); *B* reflects most of the light directly down; *C*, which is usually made of frosted glass or clear glass with crystal-like facets, scatters light in every direction. If strong bulbs are used, *A* is best for lighting a schoolroom. For a reading lamp with frosted bulb, *B* is best for the eyes.

The electric lights used in houses and other buildings give a steady light, and so they do not tire the eyes by flickering, as the other lights do.

Electric lights are very much brighter than most other kinds of light; and so we should use shades or special globes to keep the bright electric light from tiring our eyes. You have all noticed how much worse the glare is from the strong electric headlight, used by some motor cars, than it is from a headlight which is protected by a green shade or a shade of "ground glass."

Many of the electric light globes are made of a material about as transparent as oily paper. These do

not let all the light pass through. Sometimes they are made of glass which has been ground rough, or which is milky white instead of clear.

Indirect lighting is now recommended for buildings, and, although this method requires a little more light than the direct, it is a better way of lighting our houses. When you read by a lamp, as shown in Figure 88, the light falls directly upon the table; but it is easier

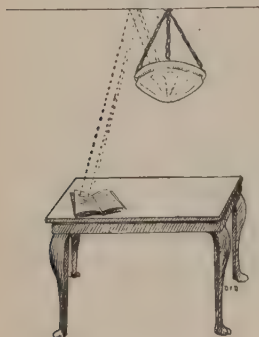


FIG. 90. With indirect lighting many lines of light are reflected to our books, as shown in the picture above. When we use indirect lighting the light from the page is never so bright or glaring as with direct light.

on the eyes to have the light reflected first to a surface that is light in color but unpolished, then to the printed page as shown in Figure 90, and from there to the eye.

If we are doing very close or very fine work, it is sometimes necessary to have a little extra direct light thrown toward our work; but for most of the things which we do in our homes and schools it is best to have only enough indirect light to enable us to do our work without any feeling of eyestrain.

Electric light is preferred by most people for several reasons. Mention all the various reasons why you

think electric light is to be preferred to other artificial lights.

The danger from fire is also much less, and this is important not only in homes, but also in garages and factories, where there are often large amounts of material which may catch fire very easily, and which may make fire difficult to control. Many a fire has been caused by the blowing of a curtain into a gas flame, or by an upset kerosene lamp.

Recently, there have been many plans proposed for getting electricity cheaper. In some parts of the country, water power can be developed and be used to generate electricity cheaply. The water power at rapids in the St. Lawrence River has been recently used to make electric current that costs so little that very tiny villages and even isolated homes can afford to use it. By the time you are able to vote on such questions, it is possible that your state may have secured already all of the advantages of the natural water-power of the state to its people, so that you may have low-priced electric current for your home and for power and light in your place of business.

Danger from gas. Many accidents happen from careless use of gas in lighting, as well as in cooking. Some of these accidents are due to the explosion of accumulated gas; as, for example, when an unlighted burner is left open in a gas oven and then some one tries to light the burner. Other accidents are due to breathing the gas. Many of these accidents would

not happen if people gave attention to proper ventilation of bedrooms at night. If you sleep in a room which has gas, be sure that it is carefully turned off before you go to sleep.

Never try to find a gas leak in a room or cellar where you smell gas by using any kind of flame for a light. Use a flashlight. You can usually locate the leak by sniffing the air near the place where you suspect gas is escaping. Usually the leak is near the burner, which has a shut-off valve that should be tightened from time to time. If you do not find the leak, be sure to report it at once to the gas company, who will send experts. You cannot be too careful about leaking gas because of the danger of explosion and of suffocation.

Caution in use of electric lights. Many fires and accidents are caused by careless use of electric currents. You know that a current will pass through your body if you take hold of both wires of an electric circuit; for example, the two wires from an automobile battery. You also know that there is a flash or spark when two such wires touch together.

These facts suggest several precautions which should be followed when dealing with electric currents used for light and power. Some of the most important are as follows:

Never stand in a bathtub or on any wet spot when you touch the metal socket of an electric lamp, or pull a chain attached to it. The current might go through your body to the water pipes or to the soil.

Safety sockets of porcelain are now made, and they are being used in bathrooms, cellars and other places. Many people have been killed in bathtubs because currents have passed through their bodies, especially when electric-light wires have been blown down by storms and have come in contact with high-powered trolley lines.

Never touch the end of a charged electric wire to any other metal. Special care should be taken to keep the two wires in an electric cord from touching each other, as may happen when the cover or insulation is worn off. Many fires are started because this rule is not observed.

Never take hold of a loose electric-light wire, such as one dangling from a pole. If it is charged, the current will pass through your body to the ground.

Never fly a kite with copper wire in place of a string. Last year a boy tried to perform Benjamin Franklin's famous experiment with lightning, but the boy was killed because the copper wire he used touched a high-powered electric wire at the top of a tall pole.

Never turn a stream of water from a hose on an electric wire. Many times a fireman has been killed when a stream of water from a fire hose touched a trolley wire so that the electric current passed through the water, the brass nozzle which he was holding, and his body, to the ground. This will suggest to you that it is dangerous to touch any metal connected with electric currents when any part of your body is in contact with water or metal.

Position of houses and sunlight. Houses should be placed so that the greatest amount of sunlight will enter the windows. The upper part of Figure 91 shows that a house which faces south will have sunshine at the windows on the north side only on the

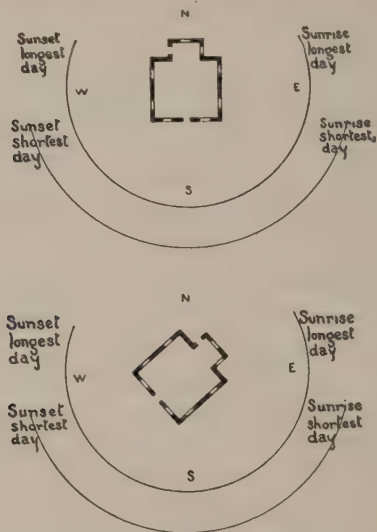


FIG. 91. One of these houses faces south and the other southwest. Can the sun shine in all of the windows of both houses on the longest days in summer? On the shortest winter days? A man in Europe recently built a house on a turntable so that he could let sunlight into any room.

longest days in summer. The lower part of the figure shows that if the house faces southwest, the same windows will have sunlight even on the shortest days of the year. Why is it important that as much sunlight as possible should enter windows?

A PAGEANT

There is material in this chapter to make a fine pageant showing what light has meant to man through the ages. (A pageant is a sort of procession in which people represent ideas or events.)

First you will need to choose the ideas you want to set forth, and then the people to represent them. These people may tell or read what they represent or one person may be chosen to read all the explanations as the different people appear.

Getting Ready for the Pageant

Read the chapter to find out what it says about lack of light or darkness, about the sun and other sources of light. Notice what is said about the effects of light, what the sun and the sun's rays do. Read to find out about the first artificial light. Trace the interesting story of artificial light through the ages. Study the pictures in the chapter. You may wish to consult other books about the ways of lighting in olden days.

Re-read this chapter to find other ideas for the pageant. Discuss plans and make a complete list of the ideas and characters which you plan to include. Be sure to arrange them in the order of their appearance.

Here are a few of the important characters and ideas:

Darkness

Firelight

The Sun

Candlelight

Clouds

Electric light

Plants that need sunlight

Germes which are killed by sunlight

Children who need sunlight to grow and become strong

Choose persons for the various parts and help them to plan what to do and say.

Have one or two rehearsals in which you help each other by suggestions and criticisms.

Set the day, invite another class or your parents to see the

"Pageant of Darkness and Light."

CHAPTER VI

CLEAN AND HEALTHFUL HOMES AND NEIGHBORHOOD

In order to learn how to make and keep our homes and neighborhood clean and healthful, we shall study, first, how to keep our clothing and our buildings clean; second, how to get rid of garbage, rubbish, and other waste or refuse materials; and third, how to remove or change sewage so that it will not affect our health.

A. KEEPING OUR CLOTHES AND BUILDINGS CLEAN

Clean Clothing. Our clothing should be kept clean, first, because soiled clothing may be unhealthful, and second, because it makes us lose our self-respect, and also makes others lose their respect for us. Do you prefer clean clothing?

Clothes should be washed in hot soapy water until they are clean. Many housewives "put the clothes to soak" the night before washing them, because it is easier to get the dirt out of them after they have soaked for a while in soapy water. If rubbing them or using a washboard does not make the dirt come out, the clothes should be boiled in soapy water. After they have been rubbed, washed, or boiled enough to make them clean, they should be rinsed until no soap or loose dirt is left in them. Warm water may be best for this rinsing, but cold water is often used,

especially for the last rinsing. A little indigo, or "bluing," is usually put into the last rinsing water to make the clothes look whiter or not so yellowish as they would look otherwise.

The water used for washing colored clothes is usually not so hot as for the white ones, because colored



FIG. 92. Visitors to France and Italy and other countries in southern Europe often see women doing the family washing at a river bank. Cold water does not make the clothes so clean as warm water does; besides, the water may be made unsafe for people who use it for drinking or bathing farther down the stream. (*Times Wide World Photos*)

materials may fade if the water is hot, especially if a great deal of soap is rubbed on them. Colored clothes should be rinsed just as thoroughly as white clothes; if the color is at all likely to "run," they should be hung up to dry as quickly as possible.

Many persons now wear underclothes which do not need to be ironed; and sometimes sheets are used

without ironing. The housekeeper who does this is spared a great deal of work. It may be a good plan to save her time in this way, so that she may use it in washing the sheets, towels, etc., oftener.

Hand washing machines and electric washing machines are now used in many families. To use the hand washing machines is work, too, but, since even the children can run them, they are of help to the housekeeper. Running a washing machine exercises the muscles of the arm and the leg, and every well member of the family would be benefited by helping with that part of the laundry work. The clothes can be left in most washing machines while the water is being changed, and therefore there is little lifting to be done.

Whenever it is possible, clothes should be dried in the sun and in out-of-door air; but colored clothes, which may be faded by the sun, are often dried in the shade.

Wet wash laundries. In many towns there are "wet-wash" laundries, which wash the clothes and return them in a wet bundle to each family, after which they are hung out to dry. This practice saves the housekeeper a great deal of hard work. Some of these laundries put the clothes from each family into a separate net or bag, and then wash many bags in one big boiler or machine. A better way is to put the wash from each family into a separate "washer" or washing machine; and in many towns the laundries have individual tubs for each "washing."

When clothes are dried at a laundry, the drying is often done in a hot room, or chamber, because there is usually not room enough or time enough to dry them out of doors. We like to have them dried in the sun, but if that is not possible it is a satisfaction to know that thorough drying and ironing with a hot iron will also kill many germs that may have been left on the clothes. However, it is not healthful to put clean but unironed clothes near dirty ones, for there is always a chance that the iron may not be hot enough to kill germs that may get on them in that way. In fact, that would be almost like ironing dry clothes before they are washed at all, and depending upon the hot iron to kill the germs.

Some families send their washing to private homes where the clothes are very carelessly handled after they have been ironed. Clothes should never be sent to be washed in homes where there are persons who are ill with communicable diseases such as tuberculosis, especially if the ill person is likely to be where the clothes are kept.

Cleaning with gasoline. Some kinds of clothing, particularly woolen clothing such as coats, cloaks, and overcoats, cannot be washed in water, and so many persons wash them in gasoline, or send them to be "dry cleaned." When we think how dirty our cotton and linen clothes become, we realize that woolen coats and dresses must also get very dirty. Cleaning fluids that will not burn, or those that do not catch fire easily, are safer to use than gasoline; but gaso-

line is so much cheaper than these cleaning fluids that most persons use it for cleaning large articles of clothing.

Gasoline should never be used indoors if there is a fire in the house, or even a small pilot flame, because the gas which forms burns very easily. Clothes that have been washed out of doors with gasoline should never be brought into the house until they have been aired so thoroughly that there is no longer any odor of the gasoline on them. Serious fires have been started by lighting gas or oil lights near clothing which had been cleaned with gasoline, and from which all the gasoline had not evaporated.

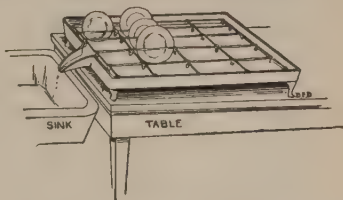
Bedding, such as quilts and blankets, should be washed or "dry cleaned" as often as it becomes soiled. Many persons use rugs which are made of rags, and these may easily be washed by a laundry, or scrubbed at home with soapy water and a brush. Other kinds of rugs and carpets are usually "dry cleaned."

Washing our dishes. Tools like forks and spoons which we put into our mouths need very careful washing, so that we may be sure that they do not carry germs from one person to another. Because most persons dislike dishwashing, many do it "any old way to get it done," and, therefore, very poorly indeed. Dishes should be washed in hot soapy water. Use enough soap to keep a good soapsuds in the dish pan. Remove all the larger particles of food from the dishes before you put them into the hot water. This may be done by wiping them with pieces of a paper towel

or of newspaper, or by holding them under running water at the sink. Change the wash water as often as is necessary to keep it reasonably clean.

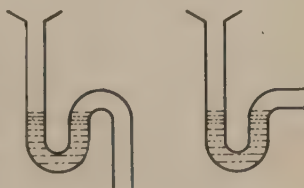
After the dishes have been carefully washed in hot soapy water, they should be rinsed thoroughly by

FIG. 93. This dish drainer is higher at one end, so that the rinsing water runs into the sink. In this kind of dish drainer, germs left on one dish cannot wash on to another, when boiling water is poured over them.



dipping them into hot water. They should be placed in a wire rack or a dish drainer, and boiling water poured over them while they stand in the dish drainer. This boiling water helps rinse them and because it makes them hot they dry very quickly, and so it is not necessary to wipe them with a dish towel. It is

FIG. 94. Two kinds of traps used for sinks and wash basins, to keep the foul air in sewers from coming into the house. The last water that flows into these traps stays there until the next time the sink or basin is used. Why should we be sure that it is clean water?



better to dry dishes by draining them than by wiping them; but glasses may be polished with a clean towel after they have drained. Dish towels rub the germs from one place and put them on another. If dishes are properly washed and rinsed, very few germs are

left on them; and, if boiling water is poured over the dishes as they stand in a drainer, any germs that are left are apt to be killed or washed off into the sink and from there into the sewer.

After using dish towels and cloths, wash them in hot, soapy water, rinse them thoroughly, and hang them up to dry in the sun outdoors, when possible. Drying

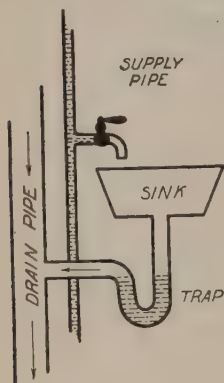


FIG. 95. When water runs from the sink it fills the pipe leading to the trap and pushes the water already in the trap ahead of it into the drainpipe. Why does every sink or washstand have a trap? What prevents foul air, gases, etc., in the drainpipe from getting into the air of a room that has a sink?

them quickly near a hot radiator or stove is the next best way. Never leave wet towels or dishcloths in a pile, even if they are to be sent to the laundry. If dish mops are used, they should be washed and dried as carefully as dishcloths; and neither dish mops nor dishcloths should be left in dark corners of a closet or kitchen. Find a dry, sunny place, whenever possible, to keep such articles when they are not in use.

Care of sinks, washbasins, etc. Sinks, washbasins, bathtubs, and laundry tubs should all be washed with

clean soapy water after they are used. After they have been carefully washed, they should be rinsed with hot, clean water, to make sure they are really

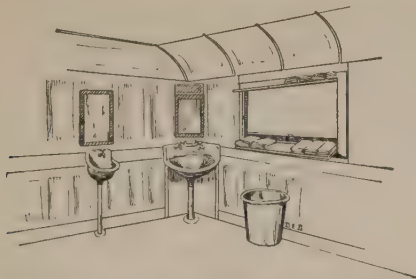
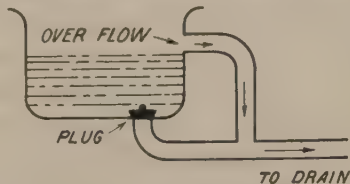


FIG. 96. Sleeping cars on many railroads have tooth basins as well as washbasins. Why is this healthful?

clean. Use plenty of rinsing water. If the last water to pass into the drain pipe is dirty water, it may give out bad odors as it stands in the trap. Be sure, then, that you use enough rinsing water to leave only clean water in the trap.

Since the germs of such diseases as diphtheria, "sore throat," influenza or "flu," and pneumonia are found

FIG. 97. This picture shows a common kind of "overflow" pipe for washbasins and bathtubs which have a plug in the bottom. What is the use of an "overflow" pipe?



in the mouth and throat, it would be possible to spread such diseases by cleaning the teeth in a washbasin which is also used for washing the face and hands.

For this reason, a separate basin for washing the teeth is provided in the washrooms on sleeping cars. It would be a good practice to clean the teeth over the toilet, or over a small hand basin which can be emptied into the toilet, or into any other safe place. Many persons in the country go out of doors to clean their teeth. If the washbowl must be used, it should be thoroughly washed afterwards, with hot, soapy water.

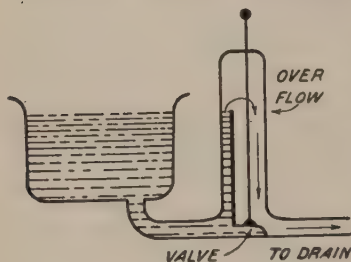


FIG. 98. This picture shows the improved kind of overflow for washbasins and bathtubs. It has no plug, but a valve which can be lifted to allow the water to flow into the drainpipe.

When washing the face and hands in public washrooms, it is best to use the water as it runs from the tap, instead of using water in the bowl.

When any member of the family has a cold or any other disease that might be spread, he should be careful not to make the basins, faucets, etc., unsafe for others. If he cannot use a separate basin, he should thoroughly wash the one he uses, as has been suggested in this chapter.

Keeping dust out of the house. Dust itself, without bacteria, is not dangerous to health unless we breathe in a great deal of it, and then it may injure our lungs. It is well known that men whose work keeps them in

very dusty places often develop lung diseases because of the long-continued breathing of dusty air. Dust may do harm by helping bacteria to float or stay in the air for a longer time than they could otherwise. For this reason, all careful people try to keep their homes free from it.

Housecleaning can be made easier by preventing dust from getting into our houses. Sometimes we can control the dust ourselves, and sometimes it should be controlled by the neighborhood in which we live. If the city or the county in which we live does not pave or oil our streets, we may sometimes sprinkle them with water when they are dusty. Many persons carelessly fill the house with dust when they take ashes out of the stove or the furnace. Is there any way to keep the dust out of the air when we remove the ashes from the stove or the furnace? How do good wooden or cement walks leading to the entrances to our homes help keep the house clean? Do any of our pets make it more difficult to keep the house free from dust?

Dusting. Feather dusters and dry dust cloths do not take up much dust. What they really do is to brush the dust from the tables, shelves, etc., and make it float around in the air; then, presently, the whole room looks as dusty as it did before.

Some of the stores now sell "dustless" dust cloths. We can make our own, however, by moistening clean cloths with water or oil. Dust cloths should be washed whenever they need it, and should be kept in a dry clean place, when not in use.

Care of floors. Carpets make dust or lint as they wear, and they are harder to sweep than the bare floor would be. For this reason many persons prefer to paint or stain or wax the floors, and to use them without any covering except, perhaps, rugs small enough to be easily handled and cleaned. Rag rugs are liked by many persons, because they make very little dust as they wear out, and are easily cleaned. Some of them may be washed in a tub just as we wash our clothes.

Many people prefer to use oilcloth or linoleum on the floors of the parts of the house that are in constant use. Linoleum makes a better floor covering than any kind of carpet or rug for rooms such as the bathroom and the kitchen, where water or food may be spilled.

When brooms are used for sweeping floors, they should first be moistened with water, to keep dust from flying into the air. Some housekeepers use clean wet sawdust, or pieces of damp paper, which they scatter over the floor before the sweeping is begun, to keep dust from being spread by the broom.

Floors may be washed with water, or cleaned with cloths wet with oil. A little kerosene oil may be used to take spots off, but too much of it will spoil the finish on "hardwood" floors. A milder oil, almost any of those sold for cleaning floors, is better to use for the regular cleaning of the whole floor.

Mops, rags, or cloths, which have oil or wax on them, should not be left where they might cause a fire,

because it is known that they sometimes set themselves on fire. This way of starting a fire is called "spontaneous combustion."

Carpet sweepers raise less dust than brooms, and they are therefore better for sweeping carpets and rugs. Most of them, however, do not clean the corners of the room very well; and so the corners of rooms and the edges of rugs should be cleaned with a moistened brush or broom, before a sweeper is used.

FIG. 99. A simple vacuum cleaner. When the handle is pulled up, air with its dust is drawn into the lower part of the tube. What happens to the air and dust when the handle is pushed down? What keeps the dust from getting back to the floor?

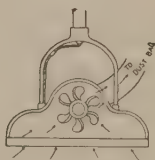
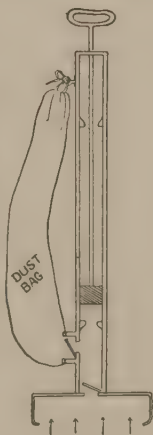


FIG. 100. Diagram showing how air with dust is drawn into an electric vacuum sweeper by a rapidly revolving fan.

Vacuum cleaners are well liked by housekeepers, for two reasons. One reason is that it is less tiring to move a vacuum cleaner over the floor than to sweep with a broom. The other reason is that vacuum cleaners take the dust out of the room without allowing much to escape into the air. Figure 99 will show

you how a simple vacuum cleaner works. If we put a little feather or a tiny ball of cotton threads near the end of the tube, and then pull the handle, the feather or the cotton will be pulled into the tube. One kind of vacuum cleaner or sweeper has a motor run by electricity, and another kind has an air-pumping apparatus worked by the wheels on which it runs. The kind which has an electric motor that drives a little suction fan at high speed is best. Both kinds draw air from the floor, just as the simple cleaner shown in Figure 99 does. Some vacuum cleaners have brushes which beat the rug or carpet at the same time that they draw the dust out of them.

Keeping the cellar clean. Unless cellars are well lighted, they are often much dirtier than we realize, and so many persons who think themselves good housekeepers may allow the cellar to become very dirty. Some persons think that they have done all that is necessary if they clean the cellar thoroughly every spring. A cellar should be kept clean if a home is to be healthful. Most cellars have only a few windows, and these are often very small ones, so that the ventilation is usually very poor. Small particles of food, or broken pieces of vegetables, should not be dropped and left on the floor. They are quite likely to decay and give off disagreeable odors which, if absorbed by foods, such as butter or milk, will make them unfit for use. A furnace or heater in the cellar, if not taken care of properly, may add unnecessary dust to the cellar as well as to the rest of the house.

Chemicals for home use. Chemicals are sometimes used to disinfect dishes, handkerchiefs, thermometers, faucets, and other articles. These are usually not necessary, for articles like handkerchiefs and bedding, which have been used by the patient, can be boiled; dishes may also be boiled, after which they may safely be washed with other dishes or used by well persons; and faucets and bowls may be scrubbed with a cleaning powder and then rinsed with plenty of hot, soapy water.

If a chemical is really needed, "chloride of lime," which is sold in cans at most grocery stores, is cheap, and as useful as the more expensive chemicals usually sold in bottles. The powder in these cans should be dissolved in water, as directed on the label, and the solution used to rinse faucets, basins, etc.

Household pests. You have already read in several other parts of this book how rats, mice, and flies may carry disease germs. The best way of getting rid of mice and rats is to use traps, unless poisons can be put where chickens, dogs, etc., will not be harmed. Our cellars, storehouses, and barns should be made rat proof and mouse proof, because each year these animals destroy millions of dollars' worth of food which we need.

Flies and mosquitoes. There are now for sale at most grocery stores several kinds of insect poisons which can be sprayed around the room to kill flies, without any danger to ourselves. A fly-swatter is a very useful tool. If we use it to kill the very first

flies in the spring, we prevent the development of many millions of flies. A female house fly lays over one hundred eggs at a time; and it takes about ten days for an egg to turn into a maggot or larva and, finally, into a full-grown fly. A pair of flies on April 1 of any given year might mean 100 flies by April 10th. If half of them were female flies, and each of those 50 flies laid 100 eggs, that would mean 5000 eggs. By



FIG. 101. The hairy body and feet of the house fly and the stable fly usually carry many bacteria; over 50,000 were once washed from one house fly. (After Hodge)

April 20, there would be 5000 flies. If half of these were female flies, how many eggs could they lay? How many flies might there be by April 30? You will see that there would be millions and millions before the first of June, and by the end of the summer more than most of you could count. Is it ever advisable to "wait until cleaning day to get after the flies"? Is it ever true that there "aren't enough flies to bother with"?

Flies and mosquitoes can be kept out of the house by screens, but it is difficult to keep them all out of

our buildings, especially if there are a great many of them trying to get in. One fly or mosquito can do a great deal of harm, and we should do everything we can to keep such insects from breeding or multiplying. See if you can find elsewhere in this book ways of preventing flies and mosquitoes from breeding. Single mosquitoes may be killed with a "fly-swatter," just as we kill flies. If the mosquitoes are on the ceiling,



FIG. 102. The croton bug is sometimes called the "water bug," because it likes the damp places sometimes found around water pipes in kitchens, etc. How does "open plumbing" help in the fight against such pests? (*After Kellogg and Doane*)



FIG. 103. The little object above is the egg case of a croton bug, from which many little croton bugs may hatch out.

they may be killed by using a kerosene cup. To do this, fasten a little tin cup on a stick, put some kerosene into it, and push the cup up around the mosquito as it clings to the ceiling; the mosquito will drop into the kerosene and be killed.

Other house pests. Croton bugs and cockroaches may be killed by using some of the liquid sprays that kill flies. The eggs left by these insects may develop after these animals have been killed, and the sprays

or powders should be used for some time after you have seen the last bug or roach. It is a good plan to paint or varnish all the floors, baseboards, etc., where these pests may hide, and then spray the liquids or sprinkle the powder in the dark corners and cracks. If the materials on sale at your grocery store do not kill these pests, write to the secretary of your State



FIG. 104. This is the American cockroach, one of four kinds found in houses and also outdoors. The croton bug (Figure 101) is another cockroach. (*After Marlatt*)

Board of Health, and apply for a circular giving detailed directions for killing household pests.

Fleas and lice. These insects affect health because their bites are so irritating and because they often carry disease germs into the blood of persons bitten. The germs of the dangerous bubonic plague of the Old World grow in the blood of rats, and fleas carry the germs into human blood.

School children sometimes get head lice. These may be killed by rubbing tincture of larkspur in the hair as directed by your druggist. A fine-toothed comb dipped in kerosene or melted vaseline is a good remedy if used daily for several weeks. Other kinds of lice on the human body are rare in most parts of the

United States, but if found, physicians should be consulted as to methods of getting rid of them.

Fleas, which are wingless, sucking insects, may be killed by insect powder and by certain liquids sold for



FIG. 105. A head louse magnified.
(From *Field Book of Insects*,
Lutz)



Fig. 106. A flea magnified. Dog
and cat fleas are the common ones
in America. (From *Field Book of*
Insects, Lutz)

use as sprays. They are fond of dogs and by frequent washing of the house dog with any flea-killing soap, the fleas in a house may be destroyed.

The bedbug. The most dreaded of all household pests is the bedbug. Gasoline and kerosene may be used in the crevices of the bed frame, the cracks of the floor, etc., but while these substances are helpful in getting rid of bedbugs there is too much danger from

FIG. 107. The bedbug has no wings, and its flat body fits into the narrowest cracks. It can live for many months without food, that is, blood. Other bugs that live in birds' nests and under the bark of trees are often mistaken for bedbugs. (After Marlatt)



fire if the floors, etc., are soaked with these substances. If bedbugs do get into a house, the best thing to do is to paint or varnish floors, baseboards, and moldings. All large cracks should first be filled in with putty and then painted or varnished over. A poison known

as corrosive sublimate or bichloride of mercury is often used to kill bedbugs. In many states it is against the law to sell this poison except on physician's orders. Many people have swallowed tablets of it mistaking it for "headache tablets" or other medicines. When corrosive sublimate is to be used for bedbugs, druggists make, or tell you how to make, a strong solution by dissolving the tablets in water. With a large feather or a small brush rub a little of this solution along the edges and tufts of the mattress, into the corners of the bed frame and along the baseboards, corners of the room, edges of the rugs, etc. Throw any unused solution into the toilet or water closet. Never leave it around, because it is a very dangerous poison.

Many drug stores sell bedbug preparations which are helpful, but there are many fake ones for sale. If you are not successful with the preparations for sale in your neighborhood, write to your State Board of Health, because bedbugs are not only annoying but also dangerous, as they may carry from one person to another any disease germs which are in the blood.

In most cities there are firms which make a business of destroying bedbugs, cockroaches, and other insect pests in houses.

B. HOW TO GET RID OF WASTE MATERIALS

Would you believe that each year in our large cities the weight of the garbage, ashes, and other waste material amounts to nearly one ton for each person? In one year New York City has for each inhabitant

an average of about 1200 pounds of ashes, 200 pounds of garbage, 100 pounds of paper and other rubbish, and 300 pounds of street sweepings. The waste materials seem less in small towns, because the inhabitants themselves often burn many of the waste materials in stoves, furnaces, and bonfires, bury them in the garden, etc. In the country some of the table and food wastes are fed to chickens and pigs. Coal ashes may be used for making paths, and ashes from wood and any rubbish which can be burned make fertilizer for the garden.

Rags and paper waste. Wherever we live, we have some wastes which must be disposed of. In every home there are papers, rags, and old clothing. In many places, papers and rags may be separated from the other rubbish, sold, and later made into paper. If this is done, it will not be necessary to use so many of our trees to make paper. Woolen waste can be used again, the wool fibers of the old goods being mixed with new wool fibers in weaving cloth for clothing, blankets, felt linings, etc. The saving of woolen rags is very important because there is not enough wool in the world to make all the woolen goods we need from new wool fibers only.

Caring for waste paper. Waste papers should be kept dry and clean, and tied and packed in neat bundles. Too many bundles should not be allowed to accumulate, as they make good hiding places for mice and insect pests, and, besides, there is always the danger of fire. Flies have been known to breed in wet, dirty paper, though they usually breed in manure.

Newspapers may be used around the house in many helpful ways. The garbage pail should be lined each time with fresh layers of paper. Newspapers should be used in much of the work in the kitchen. If newspapers are spread on the table when we clean fish, chickens, and some kinds of vegetables such as lettuce,

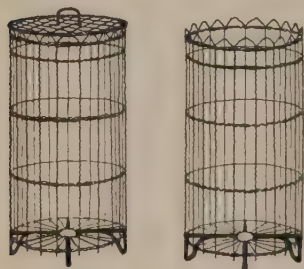


FIG. 108. Which incinerator will keep bits of burning paper from flying into the air? Either of these can be made from the woven wire fencing which farmers use.

we can wrap up all the waste in the paper when we finish our work and there will be less to "clean up."

Waste paper in the home may also be used to wrap up small amounts of garbage as they accumulate. In some cities all garbage must be wrapped in paper bundles before it is left on the sidewalk for the garbage collector. If you have a home incinerator (Figure 108), you will find that it is much easier to burn garbage if it is done up in paper packages.

Other uses for old papers. If you cannot use or sell all the old paper that collects in your home, burn it in a covered incinerator (Figure 108) and put the ashes on the flower beds or garden. The ashes should be sifted on, a little at a time, because if too much is used the plants may be "burned" or killed.

Dumping rubbish. Never dump paper or other refuse along the roadside, in a brook, or in any other places, except those set aside for that purpose. No one has the right to make the world an unattractive or disagreeable place for others. Dumping refuse into brooks is a very objectionable thing to do, for the material may be carried for long distances by the water.

FIG. 109. Cans for waste materials, such as paper and fruit skins, should be placed on street corners and in other public places.



If old dishes, kettles, tin cans, etc., are not buried, they should be broken or turned upside down so that they will not hold water in which mosquitoes may breed. It is better to bury such refuse or cover it with ashes or dirt, because animals often prowl around dump heaps and may turn over tin cans or dishes and so allow rain water to collect in them.

If you live in a town or city and go to the country for a motor ride and picnic, you will show whether you are well bred by the way you take care of the papers, bottles, and other wastes, after your picnic.

Feeding garbage to pigs. As we have already mentioned, waste food may be fed to animals or burned in stoves or incinerators. In places where there is a great deal of garbage to dispose of, as in towns, other ways are needed. A few cities have pig farms or



FIG. 110. The carts and wagons of a Street Cleaning Department should have canvas or metal covers so that ashes or garbage will not be scattered on the streets.

“piggeries” outside the city and collect the garbage for pigs. If these are well managed, the sale of the pigs will bring a profit to the city. Pigs have a few very serious diseases, such as hog cholera and tuberculosis, and sometimes an epidemic of one of these diseases kills so many of the pigs that the towns lose instead of making money.

Grease from garbage. There is usually quite a little fat in the waste from our tables and kitchens and some towns extract the fat from garbage and sell it to

factories which use it in making soap. The garbage is mixed with naphtha to extract as much fat as possible — sometimes as much as three pounds out of every one hundred pounds of garbage. After the fats are taken out, the rest of the garbage may be dried and ground up into fertilizer.

Town incinerators. Many towns find it cheaper to burn their garbage. For this purpose they use incin-



FIG. 111. This is a picture of the upper floor of a large incinerator for burning rubbish and garbage in a city. Carts are dumped near holes in the concrete floor and the refuse slides down into the furnace below the floor. Notice the large chimney.

erators. These are often so large that a whole wagon-load of garbage, papers and other refuse can be dumped into them at once.

Several furnaces may be built together in one incinerator house or plant. If properly managed, the incinerators may be kept burning constantly without buy-

ing much, if any, coal or wood. This kind of plant is easier and cheaper to operate than any other.

Salvaging refuse. When refuse is to be burned, materials that can be sold are often picked out first. Sometimes the refuse is dumped on the ground and men pick it over, taking out rags, articles made of rubber, bottles, etc. These are all sold and sometimes they



FIG. 112. These houses in Liverpool were made from concrete in which were used the ashes of burned refuse. (*From Goodrich's Refuse Disposal and Power Production*)

bring so much money that men will contract to pay for the right to collect and to take care of the garbage.

Dumping refuse. Sometimes, small towns and cities dump refuse on any near-by waste place, such as a marsh, or an old quarry. Dumps attract rats, and in the states where diseases like the plague sometimes appear, such dumps are very likely to prove dangerous because the fleas that carry plague live on

rats. Refuse dumps may have many little hollows filled with water in which larvae of mosquitoes may develop or there may be decaying material in which flies are likely to lay their eggs.

Garbage is not dangerous in itself, but the insects and rats that may multiply in such places are dangerous to health. Besides, such dumps are unsightly.

Garbage cans in the home. It is easier to keep a garbage can clean if it is lined with several layers of

FIG. 113. This waste can for a doctor's office has a lever at the bottom, and when it is pressed with the foot the lid is raised. Garbage cans for the kitchen are now made this way.



newspapers which may be dumped out with the garbage. In some cities paper must be separated from garbage.

Many hardware dealers and mail order stores now sell for one or two dollars garbage pails whose lids can be lifted by pressing a foot pedal (see Figure 113). The best ones have an inside pail which can be removed for cleaning. Can you think of any reason why lids should be lifted by a foot instead of a hand?

Use a small covered pail to collect the garbage in the kitchen and empty it occasionally into the larger can which is kept out of doors. Wash and rinse the

indoor garbage pail just as you do any of the pails or kettles used in the kitchen; never let your kitchen garbage pail become bad smelling and coated with grease.

The outdoor garbage can should be kept in a sunny spot. It should always have a close-fitting top to keep flies, dogs, rats, and other animals from getting into it and scattering the garbage.

Barn wastes affect health. One of the health problems every farmer, as well as every village, town, and city, has to solve, is how to remove animal wastes from barns and other buildings where horses, cows, pigs, chickens, etc., are kept.

One danger in allowing manure to accumulate is that it attracts flies which are hunting for food, or for places to lay their eggs where the young maggots may find food when they hatch. Over 12,000 fly eggs and larvae have been counted in one pound of barnyard manure. Within ten days these eggs will develop into flies ready to lay more eggs. How many flies does that mean for that pound of manure? Remember that each of the 12,000 flies may lay at least 100 eggs. $12,000 \times 100 = 1,200,000$ flies in another ten days.

Rats and mice, as well as flies, feed on manure, and they may carry decaying material and bacteria to food in our homes. Screening our homes and killing animal pests will help protect our foods, but it is certainly in the interest of good health to pay strict attention to the places where these pests live and multiply. Even when privies and barns are a long way from the house, flies and rats find their way back and forth between

them and the house very quickly, and often in large numbers. Many farmers raise more flies in their barnyards than their children could kill, even if they killed a thousand flies every hour.

Disposal of barn wastes. Stable floors which are made with cement can be kept clean much more easily than wooden ones. In many of the best cow barns with concrete floors (see Figure 81) the whole floor may be washed very easily, and all wastes washed into

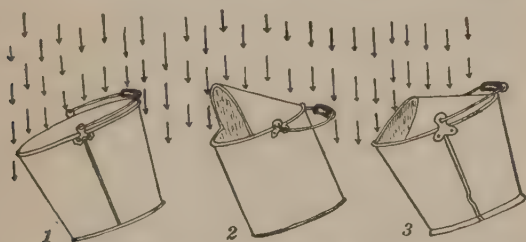


FIG. 114. If each arrow means a bit of falling dust, which milk pail (1, 2, 3) will catch the most dust? Milk pails such as these are sold by dealers in tinware. Which one would you buy?

gutters and out of the barn into a manure pit, or into drain tiles which lead into cultivated soil.

If the floors of cow barns are kept clean by daily washing, and if the cows are carefully brushed and cleaned before milking, there is much less chance that dust-carrying bacteria will fall into the milk pails. However, it is impossible to avoid having some dust in the air of barns, and therefore it is best to have improved milk pails like 2 and 3 in Figure 114. The kind like 3 may have the opening covered with ster-

ilized cheesecloth through which milk will strain and leave dust particles on the outside of the cloth.

Many farmers are very careless and allow their cows to stand in barnyards which have pools of dirty water and large piles of manure. Clean and healthful milk cannot be produced under such conditions.

House wastes. In many towns and in all large cities most of the waste from kitchens, laundries, and bath-

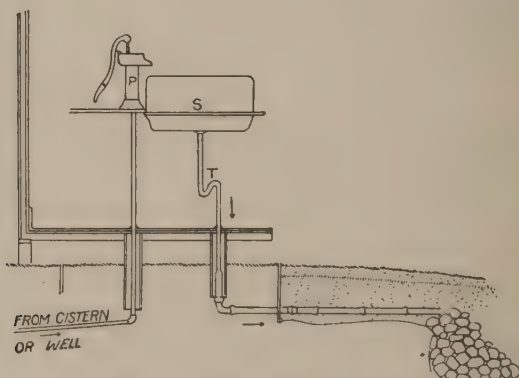


FIG. 115. Where there is no sewer system, the kitchen sink may be connected by lead or iron pipe to an underground line of drain tiles leading into a pile of stones or gravel. *P*, pump attached to pipe from cistern; *S*, kitchen sink; *T*, trap to prevent odors from escaping into the room.

rooms is carried away in underground pipes called sewers. But there are many thousands of homes, especially in the country and the smaller towns, where each household has to care for its own wastes.

Dishwater and laundry water are often thrown out upon the ground near the house. Usually the ground

becomes soaked and sour smelling and scraps of food in the dishwater attract flies. The soap and tiny particles of food in dishwater are good for plants, and (if there is no drain as in Figure 115) it can be poured in small amounts near the plants in the garden.

For any home that does not have connections with a sewer into which dishwater and laundry water may flow, the simple arrangement shown in Figure 115 is recommended by experts on health science. It consists of an iron sink connected with lead or iron pipe to a line of sewer pipe or tiles extending underground fifteen to forty feet from the house into a drainage pit several feet deep. This pit should be almost filled with stones, broken bricks, or coarse gravel, and on this should be spread a few inches of soil or cinders to keep flies out and to avoid the unsightly appearance of an open drain. Waste water will drain away from such a pit rapidly if the surrounding soil is loose. Drainage pits should never be dug where water is likely to filter through the soil into a well.

If the soil near a house is clay through which water soaks very slowly, the pit should be shallow and large in diameter so that some of the waste water can evaporate through the loose soil or cinders at the surface.

Instead of emptying into a pit filled with stones, the drain pipe may be extended as in Figure 117.

C. SEWAGE DISPOSAL

Importance of sewage disposal. Sewage usually means the mixture of water and wastes which flow out

of buildings through underground pipes called sewers. The sewer pipes in a house include all those which drain waste water away from sinks, tubs, and water closets in kitchen, laundry, and bathroom. The waste water runs down into larger pipes through the cellar or basement into the sewer under the street. The whole set of pipes which drain water away from sinks, tubs, etc., in a house is called the house sewer system.

An enormous amount of money has been spent in Europe and America during the past thirty or forty years in providing better sewage disposal in cities and even in villages and on farms. The reasons for doing this are, first, that a good method of sewage disposal prevents disagreeable odors in house and neighborhood, and second, that it reduces the danger of spreading certain disease germs, such as typhoid.

It is now well known in health science that the wastes from the human body, which in books of physiology are called excretions, may contain the bacteria which cause such diseases as typhoid and Asiatic cholera and also may carry hookworms (Figure 126) and other worms which can live in the human intestines. Only wastes from persons suffering from these diseases are dangerous to the health of other persons, but it is not possible for even the best physicians to discover easily just what persons are carrying disease germs. Therefore, experts on health have decided that since any sewage waste may contain dangerous germs, it should be treated so that there will be no chance of any such germs infecting healthy persons.

Why city people should know about disposal of sewage in the country. Every one of us, whether we live in a city or whether we live in the country, should know the most healthful ways for the disposal of sewage. City people may not need to know this so far as their living in the cities is concerned, because the city sewer systems are operated under the watchful eyes of sanitary engineers and other health officers. But city people often go to the country or small towns where there are no sewers, and there they often catch intestinal diseases because water or foods have been contaminated by sewage. In addition, they often bring disease germs with them when they return to their homes. For example, many of the cases of typhoid in cities in the autumn are called by physicians "vacation typhoid," because the patients got the typhoid bacteria into their intestines when they drank or ate water or food containing these bacteria during vacation in the country.

On holidays and week-ends, hundreds of thousands of city people in America hike, motor, or go by train into the country, and many of them never stop to consider what are healthful ways of disposing of wastes. Of course, persons with habits of neatness do not scatter waste paper, fruit skins, tin cans, and other litter along the roadside or in the fields where they picnic; but we know that many persons are careless or selfish about such things and, as a result, many roadsides and picnic grounds are indescribably dirty after a holiday. We hope this will not be the case after a few more years, because millions of pupils in schools, the Boy

Scouts, the Girl Scouts, the Camp Fire Girls, and other groups of young people are learning how good citizens act when they motor or picnic in the country. Only the down-and-out kind of people keep a lot of trash and garbage in and around their homes; and we are rapidly coming to think that those who scatter rubbish along the roadsides and in the fields belong in the same class.

Habits of neatness should apply not only to disposal of ordinary wastes, but especially to body wastes. These should never be left uncovered, and care should be taken that these wastes do not find their way into water supplies, such as springs, reservoirs, streams, and wells which others are using or are likely to use. This is one reason for prohibiting swimming, camping, hunting, or picnicking on the shores of reservoirs which supply water to towns and cities. Health officers know from experience that ignorant or careless persons may contaminate water, and there is always a chance that waste matter may contain disease germs.

One of many examples of spreading of disease is the case of sixty-four boys and other picnickers who during the summer of 1924 contracted typhoid in the New York-New Jersey Interstate Park because the drinking water they used had been polluted by other visitors and campers. At least one of these careless campers must have been producing typhoid germs in his body, that is, he was a "typhoid carrier" (see p. 257).

One of the most important questions to settle in selecting a house, camp, or boarding place in the country,

even for a single meal or a single night, is whether or not the sanitary arrangements are such that there is little chance of the water supply being polluted or of flies carrying disease germs to food. This means that when city dwellers are selecting their stopping places in the country, they should look around to see that there is a water supply such as is approved in Chapter II in this book, and that the method of sewage disposal is such that the water is protected against contamination. If you are choosing a boarding place in the country where there is no community sewage system and water supply, you will be safer where there are deep wells with cemented or metal linings and where sewage is made harmless by running it into underground tanks (called "septic tanks") in which sewage decays until all harmful bacteria are killed.

We see, therefore, that city people who visit or travel in the country need to know about disposal of sewage in the country.

Sewage disposal in the country. The following information will be useful for those who live in the country all the year and also for those who buy or rent summer homes and camps. Nowadays many homes, even in the country, are supplied with running water which can be used to carry house wastes away in underground pipes or sewers. Without running water, we must use pit closets, vault closets, or chemical closets for our country homes as well as for our week-end "shacks," camps, and summer homes.

Outdoor toilets or privies should always be placed

as far as possible from springs and wells and on a much lower level, if the ground is sloping. If this is done, sewage will not be likely to soak through the soil into the water supply. The building itself should be made fly proof, for otherwise flies may carry to our foods the germs of such diseases as typhoid and dysentery. In order to keep flies out, ventilators, windows, and doors should fit snugly. The windows should be screened so that they may be left open for ventilation. The doors should have spring hinges which will close them and keep them closed. Unless there is a tight foundation, dirt should be piled up around the bottom so that animals, such as flies, bugs, rats, and chickens, cannot get at wastes and scatter disease germs.

The out-door toilet easiest to build is the pit kind. This is best for temporary camps and many summer cottages. The pit is just a hole in the ground, and the house or closet is set over it.

Permanent kinds of pits or vaults may be built of stone, brick, or cement. Directions for making these may be obtained from state departments of health or health officers. Write to the U. S. Department of Agriculture, Washington, D. C., for bulletins on sewage disposal for country homes.

Sewage disposal in septic tanks or vaults. When sewage is allowed to stand in a vault or tank it decays, that is, it is broken up into very small particles by bacteria. When this decay goes on long enough, most of the sewage is changed to a liquid condition and some invisible, odorous but harmless, gases are given off into

the air. The liquid sewage is harmless and may be allowed to run into tile drains or even into streams. Some sediment, often called sludge, collects in the bottom of septic tanks.

A small septic vault for a single house is shown in Figure 116. Its concrete walls keep the sewage in the vault until most of it has decayed into liquid and gases. As this takes place, the gases escape and the liquid runs out slowly through a sewer pipe.

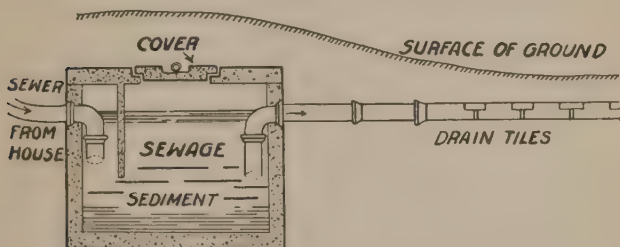


FIG. 116. This is a diagram of a simple septic tank for house wastes in private homes supplied with running water.

This pipe is connected with a long line of drain tiles, which are about twelve to eighteen inches below the surface of the ground of a lawn or garden. The liquid sewage oozes out into the soil between and around the tiles, which are laid as shown in Figure 117. The sewage will ooze out faster if loose stones, gravel or cinders are piled around the ends of each tile.

Such a septic tank or vault is the safest method of sewage disposal for homes where there is running water for operating a water closet in a bathroom but where

there is no connection with a public sewage system. We shall see later that the large sewage systems of



FIG. 117. The sewage from this house flows to a double septic tank; from the second tank the liquid sewage flows to the drain tiles laid under the lawn or garden. A septic tank like Fig. 116 could be used instead of the double one shown in this picture. (*Southern Sewer Pipe Works*)

cities depend upon decay of sewage just as in the small septic tanks for homes.

If there is no running water in a house and an outdoor closet is necessary, it is possible to make a very safe sewage disposal vault as in Figure 118 under the closet

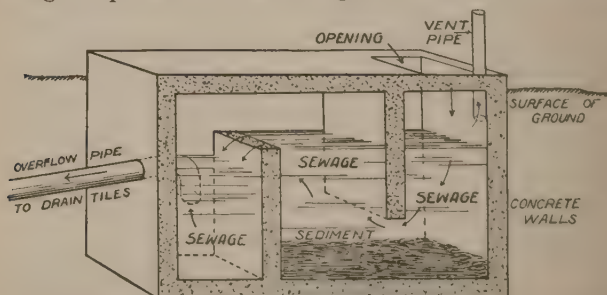


FIG. 118. This is a diagram of a septic tank which is safe for use in town and country houses that do not have running water.

or privy. This is the safest kind of outdoor closet for use where there is danger of sewage soaking through soft soil into the water supply.

Such a vault with concrete walls is first filled with water, and after that only a few pailfuls each week will be required. A drain from a kitchen sink, as in Figure 115, would supply enough water. Any sewage placed in such a tank will decompose rapidly by action of bacteria.

Cesspools. Cesspools are large underground vaults or tanks used for sewage disposal for many houses,

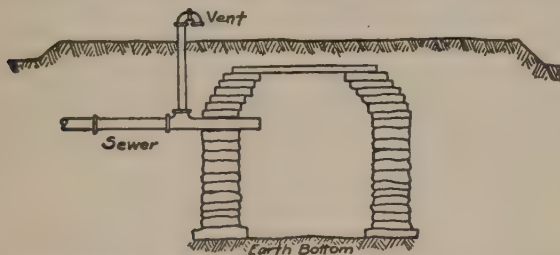


FIG. 119. A cesspool with walls made of stone without mortar so that sewage can ooze out into the soil. (*N. Y. State Department of Health*)

usually in villages, if there is running water and a sewer system in the house but no possible connection with public sewers. There are two kinds of cesspools. One is built of concrete or brick laid with mortar and has a tight floor and walls; the other has very open or loose ones (Figure 119). The tight-walled cesspool is a large septic tank. In the loose-walled cesspool the sewage runs out through the walls. Loose-walled cesspools may be dangerous because disease bacteria from the sewage may get into the wells.

How cities dispose of sewage. In cities where the house wastes are carried out through pipes to street sewers, there are thousands of gallons of sewage to be disposed of each day.

When a city is near a large body of water, an ocean, a river, or a lake, the sewer pipes are sometimes laid far out into the water, often a mile or more, so that the sewage will be emptied a safe distance from shore. Sometimes the sewer pipes do not run out far enough and then some of the sewage comes back to the shore, spoiling the water supply or the bathing beaches. Many cities spoil the water for people living farther down the river or on the same coast. In this way, towns have given typhoid fever to other towns, even forty miles away. Because of this, each town should treat its sewage so as to kill disease germs before permitting it to flow into a lake or river.

Many cities located on lakes and rivers now treat their sewage from houses and streets by running it into great uncovered tanks, usually made of concrete. As an example of the great size of some of these tanks, those at Columbus, Ohio, shown in Figure 120, hold twenty million gallons of sewage. This is equal to 400,000 barrels of the usual fifty-gallon size.

In such large tanks the sewage decays rapidly, just as in small septic vaults or tanks like those shown in Figures 116 and 118. As in small tanks, sewage is decomposed into harmless gases, which rise into the air, and into liquid waste (called "treated sewage") which is usually allowed to run into a near-by stream or lake.

Some cities in Europe and America use the liquid waste for irrigating agricultural land. The sediment or sludge may be used as a fertilizer (see Figure 123).

In some cities there is a line or series of tanks and the sewage is allowed to run slowly from the first tank to the



FIG. 120. A view of the septic tanks at Columbus, Ohio. They can treat twenty million gallons of sewage per day.

second and from this into the third and so on. When the treated sewage runs out of the last of the tanks, it has become changed so much that most — sometimes all — of the disease bacteria that may have been in the sewage are dead.

Some cities treat sewage by first running it through septic tanks and then exposing it to air as follows: The liquid sewage which flows from the tanks is allowed to run over a big bed of gravel or small stones several feet deep, which is often called an “air bed” because much air is between the small stones. In some cities the sewage is pumped and sprayed over the air beds (see Figures 121 and 122). In all air beds sewage trickles

down between the stones, and mixes with the air that is between them. By the time the treated sewage has



FIG. 121. This is an air bed which helps purify the sewage of Columbus, Ohio. Many little sprays are shown in the picture. A diagram of one such spray is shown in Fig. 122. There are hundreds of them in a big disposal system. (*Courtesy of C. B. Hoover*)

reached the bottom of these beds, it has been changed or decomposed much more than it was when it left the

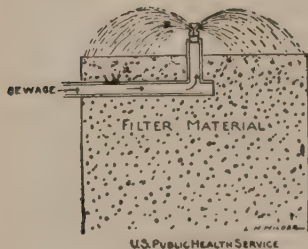


FIG. 122. This is a diagram of one of the sprinklers in Fig. 121. Sewage sprays like these carry air down into the bed of filter material (gravel and rough stones). The oxygen in the air helps the bacteria decompose the sewage.

last septic tank. In some cities the treated sewage from the septic tanks is pumped over one of these air beds and then over a second one.

In one of the newest methods of mixing air with sewage, air is forced into the bottom of tanks filled with sewage and the whole mass is thoroughly mixed with air bubbles. Rapid changes of the sewage then take place.

It is usually safe to allow sewage which has been treated in either septic tank or air bed to run into any



FIG. 123. Wheat 63 days after planting. Each pot contained sand to which had been added some plant foods except nitrogen. Pot 2 had also fertilizer which furnished nitrogen, and pot 3 had dried sludge from treated sewage. Is dried sludge a good plant food? (*From University of Illinois Bulletin.*)

river or large lake that may be near. Cities keep trained chemists and bacteriologists in their health departments to examine treated sewage so as to find out whether it contains dangerous bacteria.

There are many other ways of treating sewage, but septic tanks and air beds, described above, are the most important ones. If you live in or near a town in which the sewage is "treated," try to visit the sewage disposal plant and learn whether your city uses both of these treatments — the septic tank and the air beds. Make a drawing and write a short description of the disposal plant which you have visited.

SUGGESTIONS FOR STUDY

This chapter can be divided into three parts. The first paragraph tells you what they are. Look at the sub-titles and illustrations. Glance through the chapter in order to get a notion of the chapter as a whole.

Choose one part for special study. Think of questions which you should be able to answer after you have studied your special topic. Plan a written report of your study.

Suggestions for Making Reports

1. Your report is to be read, used and judged by your classmates.
2. You will have a chance to see and read the reports of others in the class.
3. Your report should answer your own questions about the topic.
4. The first page of your report should interest people and give them an idea what the report contains.
5. The whole report should be carefully planned, neatly written, illustrated with sketches or pictures clipped from old magazines.
6. The finished report should be in the form of a booklet, with the title and author's name on the cover.

CHAPTER VII

KEEPING WELL IN HOME AND NEIGHBORHOOD

Much illness is caused by germs, such as bacteria, but some of it is not caused by germs at all. Improper food and bad living conditions, such as poor ventilation and lack of exercise, also lead to disease. Accidents and injuries of various kinds also cause much ill health.

Many cases of illness could be prevented by knowledge and care; and while we are well is the time to find out how the common diseases are caused, how to care for those who are ill, and how we can prevent diseases from spreading through the neighborhood.

Foods and health. Some of our illness is caused by not making the proper selection of foods, by not eating enough of certain foods, or by eating foods which we cannot digest.

Too much food makes extra work. If we eat more food than we need, it makes extra work for the body; the body tries to digest all the food we give it, and that means extra work for such organs as the stomach and intestines. A large part of the sickness and deaths of older people is caused by disease of these organs, and they should not be made to do any unnecessary work.

Too much food is quite likely to make us become heavier or fatter than we should be; many persons weigh fifty or a hundred pounds too much. That means that the muscles have to do more work than they should to help them move — not only in climbing up stairs and hills, but in walking on level ground. Would it make you more tired if you had a fifty-pound sack of flour or any other heavy weight tied on your back all day long? Even ten pounds would be a burden, yet people think very little about being careful not to add ten or more pounds of fat.

Too much fat may make it hard for the lungs and heart to do their work. The heart may feel this more than the lungs, because the extra masses or layers of fat make it harder for the heart to pump blood into the blood vessels. Does this paragraph explain why it is the stout people and not the thin people who are most likely to “pant for their breath” or “have their hearts give out” as they climb hills and stairs?

Minerals and vitamins help prevent disease. Some of our diseases are caused by eating the wrong kinds of food, eating too much of one kind of food, such as fats, or not eating enough of some kind necessary for the body.

Some persons cannot digest sugars or fats easily. Too much fat may cause nausea or indigestion. Diabetes is a disease in which the body does not take care of sugar in the right way, and those who have the disease have to be very careful indeed about the kind and amount of sugar they eat.

Until a few years ago the only treatment for diabetes consisted in keeping sugar and starches out of the patient's diet as much as possible. Recently there has been extracted from the pancreas of sheep and other animals a substance known as insulin, which has proved very successful in the treatment of persons who have diabetes.

Some of the most common diseases of little children are caused by not having enough minerals and vitamins in their food. Since these are found in milk, eggs, fruits, such as oranges and tomatoes, green vegetables, and whole wheat bread, such foods are necessary for growing children. If children have plenty of the foods which contain vitamins they are not apt to have rickets, a disease which causes the bones to be improperly formed, the joints to be defective, or the muscles to fail in their work. Scurvy is another disease which is growing less common since we have learned that the vitamins found in milk, tomatoes, cabbage, oranges and other fruits, will prevent it. Heated or cooked milk may not contain as much of the vitamins as we need, and little children who live mainly on pasteurized milk should have some orange or tomato juice every day. Pellagra is a disease sometimes found in our southern states, in which the skin may have large spots that look like burns. People once thought this disease to be caused by eating moldy or spoiled cornmeal, but scientists are beginning to think that it is caused by not having the right kinds of food in the diet, especially proteins

and vitamins. Scurvy and pellagra are probably not "catching" at all, even though they do seem to spread through a family or household. The people living together in the same household probably develop the same diseases because they all eat the same food and are affected in the same way by their faulty diet.

Occasionally we hear of a person who cannot eat milk or eggs or certain fruits, such as strawberries. Such persons are very unfortunate, because it may be difficult for them to get all of the foods that they need for good health. When such persons eat these foods that do not agree with them, fits of sneezing, "running of the eyes and nose," "hives" or a rash may result. These effects are both unpleasant and uncomfortable, but fortunately it is now possible for doctors to give special treatment to make it possible for such persons to eat milk, eggs, strawberries, etc.

Foods that may be poisonous. Mushrooms are often used in cooking because they give a very different taste or flavor to other foods. There are some mushrooms which are poisonous, even after they are cooked. It is not possible to give you rules or pictures which will protect you, and since poisonous mushrooms may affect us very suddenly, causing dizziness, blindness, nausea, intense pain, and even death, we should be very careful to eat only mushrooms which we feel sure are safe. Mushrooms sold in bottles, cans, etc., at the stores are safe; so are the boxes of mushrooms commonly sold in markets and grocery stores, because

these are grown in caves or mushroom cellars made for that purpose. It is not safe to eat mushrooms which have a milky or a colored juice, which grow out of a little cup at the bottom of the stem, or which have a bitter taste. Cooking mushrooms with salt or with a silver spoon or fork in the pan does not make poisonous mushrooms safe.

People ignorant of the particular kind of mushroom that grows in a locality may so easily pick the wrong kind in the fields or woods that we should be very careful to eat only those mushrooms which have been collected by persons who are used to doing it. In Italy there is a good yellow mushroom which looks very much like one of our poisonous yellow ones. People who have picked the yellow mushrooms in Italy, often pick ours, thinking they are good, and eat them with fatal results.

Some "greens," like pokeweed, may cause poisoning also. It is best to avoid all such "greens," and to plant kale, spinach, etc., in our gardens for "greens." It is always safe, however, to eat dandelion greens.

Diseases carried by foods. Before we knew as much about bacteria as we do now, people were often made ill by eating foods which had harmful bacteria in them. Not knowing about bacteria and how they grow, they thought that the food was the cause of their illness and so they blamed such foods as oysters, milk and fish because they happened to have disease organisms in them. If people with sore throats or tuberculosis handle milk, they may add some of their disease germs

to the milk. If oysters grow in water containing sewage, dysentery or typhoid bacteria may be found in them, and any one eating them raw may develop these diseases. If fish, poultry, lobsters, shrimps, or crabs begin to decay before cooking, they are very apt to cause poisoning of any one who eats them.

Sometimes people who seem well carry disease germs in their bodies. One man who had typhoid carried



FIG. 124. Ten trichina worms were curled up between the slender muscle cells in a piece of lean pork from which this drawing was made; 80,000 have been found in an ounce of infected pork in Europe. If eaten uncooked, these worms grow in the human muscles and cause a terrible disease. Only thoroughly cooked pork should be eaten. (*After Leuckart*)

the germs in his intestines for over forty years, and caused an epidemic of four hundred cases of typhoid in New York City because he was engaged in distributing milk sold there. He, of course, had no idea that typhoid bacteria were still living and multiplying in his body. It is very difficult to be sure that the hands do not become soiled from the clothing, etc., and people who are unfortunate enough to have had typhoid or dysentery should not handle milk or work as waiters or cooks unless doctors find that the germs are no longer growing in their bodies. Most people who have such diseases do become entirely well and therefore do not spread typhoid bacteria.

Every city has records of sad experiences due to people who spread disease germs through foods. In

California, a few years ago, ninety persons came down with typhoid after eating macaroni at a church supper, because the woman who prepared it did not know that she was a typhoid carrier. If the macaroni had been thoroughly cooked, the typhoid germs would have been killed.

Why do large cities, like New York, make waiters and other people who handle food in restaurants and hotels take a health examination before they give them permits to do such work? Are there any ice cream parlors, lunch wagons, or other food places in your town where the workers should be subjected to a health examination?

Cooking usually kills human disease germs and other poisons, and many people have been surprised to hear that certain cases of illness have been caused by canned foods. It takes a high temperature to kill some bacteria, higher temperatures than occur in boiling, and if such bacteria are in food that is to be canned they may live through the canning process.

There have been numerous cases of food poisoning in the United States due to canned beans, spinach, meats and even fruit. Sometimes we can tell when a can of food is spoiled because the ends of the can bulge out when the foods have fermented and produced gas, or because the foods have an odor or appearance very unlike that of well-preserved ones. We should never use any canned food that looks or smells "queer" or spoiled, because it may contain poisons which act very quickly, and by the time we

know we need a doctor it may be too late for him to help us. Illness from canned goods is not very common. It can be prevented by canning only good wholesome foods, boiling the foods for the full time when they are being canned, and cooking them thoroughly after we open the can.

All raw vegetables should be washed very carefully before they are eaten. Radishes should be washed or

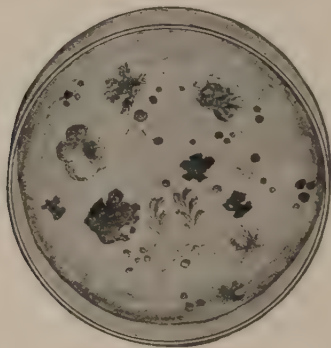


FIG. 125. A radish was washed in water and a little of the wash water was put into this dish of gelatine. In two days the bacteria grew into spots large enough to be seen. Why should we wash thoroughly all fruits and vegetables which are eaten raw?

scraped until they are really clean, and then rinsed in several waters. Lettuce or celery should have all the dirty outer parts taken off before they are put into the first washing water. The leaves or stalks should be cut off or pulled apart as they are washed, so as to make sure that no soil is left between them. It is easier to get such vegetables clean if the wash

water is slightly warm, and if the vegetables are allowed to stand in water for a short time before washing. Many persons are very careless about washing vegetables that are eaten raw, and careful housewives should supervise other persons who help prepare the vegetables.

Water and disease germs. Since sewage from our privies or house toilets often gets into the water supply, we have had many epidemics of dysentery and typhoid caused by water. In a town of about 8000 people, over 1000 cases of typhoid developed one spring because a man living on a hillside at the edge of the town went on a visit and returned with typhoid. Instead of disinfecting his wastes, the people who cared for him threw the wastes out on the hillside and they were washed down into the town reservoir.

In 1924 over sixty people caught typhoid from drinking water from a brook running down the Palisades into the Hudson River. The water looked clear as it tumbled down the rocky slopes, but it had in it typhoid germs from the ground at the top of the Palisades where there was a big automobile camp.

When water freezes, most of the bacteria are killed. Ice may be safe even though made from unsafe water, but we can never be sure that the ice is safe unless we know that it has been made from pure water. Only such ice should be put into our water, milk, or other food.

Ice is often touched with soiled hands, dragged over dirty pavements, and handled in other dirty ways.

Even though made from pure water, it should always be washed very carefully before we use it.

Insects and health. Flies, as we already know, often carry disease germs to our foods. Other household pests, such as cockroaches and croton bugs, should also be prevented from living in our houses, as they too may carry disease germs to our food.

Mosquitoes may also be carriers of disease germs to human beings. They can live on plant juices, but they prefer blood. If a certain kind of mosquito has bitten a person who has malaria, it will give the disease germs to other persons. Another kind of mosquito will in the same way give the germs of yellow fever to other people. If a case of malaria or yellow fever develops in your town, the one thing that must be done to protect other people is to screen the patient's room so as to keep out all of the mosquitoes. There is no danger to those who nurse the patient unless they are bitten by mosquitoes which have already bitten the patient or some one else infected with one of these diseases.

Along the western and southern borders of our country we sometimes hear of plague which is brought in by rats on steamers from Europe or Asia. These rats have the plague bacteria growing in their bodies and if the fleas which feed on these rats bite human beings, as fleas sometimes do, the persons bitten may develop plague. When plague is known to be present in foreign ports, all vessels coming to the United States from those ports must be disin-

fected, so as to kill any rats which they may be carrying, before the vessels land on our shores. Rats sometimes travel from a boat to the shore by running along the ropes which hold the vessels to the docks, and to prevent their doing this, sheets of metal are placed on these ropes so that if any rats are in the vessel they cannot get past them to the shore.

During the Great War a great many people died of typhus fever. After it was found that lice could carry the typhus fever from a patient to a well person, the American army was careful to disinfect all of the soldiers' clothing. Any soldier who was overseas will tell you about the disinfecting stations in which the clothing was steamed while the soldiers were taking a full bath. In this way no lice were left to bite them afterward and cause typhus fever.

Disease germs in the air. Long ago people thought that our diseases were carried by the air. They called malaria by that name, because *mal* means *bad*; and they thought that malaria was caused by breathing bad air, such as night air, especially in marshy places.

We now know that mosquitoes fly more at night than in the daytime, and also that they breed in water. Therefore the people who are out at night, especially in low or marshy places, would be the ones most likely to be infected by germ-carrying mosquitoes. People who have to be at night in places where mosquitoes and malaria are common, should wear mosquito-proof clothing and hats with netting or face protectors.

When we have sore throats, influenza, pneumonia, or tuberculosis of the lungs, we may sneeze or cough disease bacteria out into the air. These bacteria cannot grow in the air, and they usually become dried and dead in a day or so. But as long as they are still alive, they may cause disease in another person. Why is it dangerous for a person with measles, or a cold in the head, or a sore throat to cough directly into your face? Why is it wrong for people to put soiled handkerchiefs where other people have to touch them? Is giving a "handkerchief salute" to a speaker or lecturer a healthful thing for an audience to do?

Sunlight helps to kill bacteria, as we have learned on page 194, so we should air and sun our bedding, rugs, and carpets as often as we can. A great many people do not know that the sunlight kills bacteria, and even those who do know often keep their houses unhealthful by shutting them up to keep carpets and curtains from being faded by the sun.

Diseases spread by contact. Most of the diseases that we catch from other people are spread by unhealthful habits. Children sometimes exchange candy, pencils, or toys that they have had in their mouths, or they drink from the same cup. Kissing, too, often spreads colds and sore throats. Look at the table on pages 282 and 283. How many of the diseases in that list might be spread by kissing, coughing, or using the same glass or cup? When diseases can be spread in such ways as these, we say that they are "catching" or *communicable* diseases. Why do we call diphtheria

and scarlet fever communicable diseases? Is whooping cough a communicable disease?

Care of articles used by sick persons. Sunlight, as we have already learned, kills many of the bacteria that are common in water, air, and even dust and soil. But we often want to be sure of killing them very quickly, especially when they are on dishes, towels, handkerchiefs, or bedding which has been used by a person sick with a "catching" disease. The simplest way of killing the bacteria is by boiling these articles in water. Dishes and table silver may be put

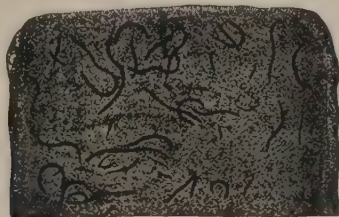


FIG. 126. Hookworms get into the body by wriggling through the skin. They can enter through the thin skin between the toes very easily, and persons who go barefoot in regions where hookworm is known to be, may become infected unless safe privies or toilets are used. (*After Wilder, Hampton Agricultural Institute*)

into a pail and covered with water, which should then be brought to the boiling point and kept there for five minutes. Handkerchiefs, towels, etc., which may have on them the germs of disease, should be boiled before they are put with the rest of the laundry.

Disinfecting during an illness. Handkerchiefs, bedding, and any other things which may have disease

germs should be disinfected as soon as possible after they are used. If we take care to disinfect dishes and other articles used in the sickroom at the proper time, there is usually no need for disinfecting rooms or

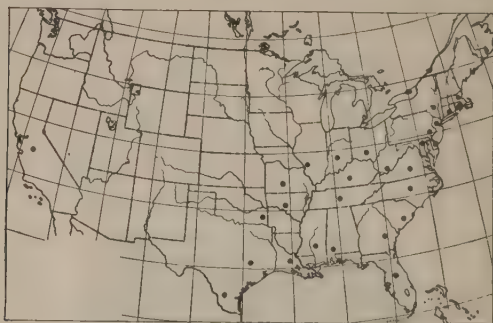


FIG. 127. The black spots on this map indicate the states in which malarial mosquitoes are most common in swampy regions. There are some in other states.

houses with sulphur or formalin after the patient recovers. Instead, we should sun and air the room and its furniture thoroughly, wash and sun all the bedding possible, scrub or oil all the floors, wash or varnish the woodwork, and, if possible, put new paint or paper on the walls of the room used by a sick person.

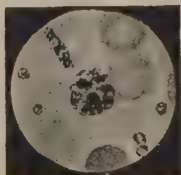
Curing diseases. One sure way of preventing the spread of communicable diseases would be to cure all of the persons who have such diseases. For example, a mosquito which bites a person *cured* of malaria does not get any malaria germs to carry to any other person it bites. In the case of a few germ diseases we

have drugs which can be used for their cure; for example, quinine, if given to persons who have malaria, will kill the malaria germs in their blood.

The hookworm disease, too, may be cured by drugs, such as thymol or carbon tetrachloride, which kill the hookworms living in the intestines, and then a dose of salts or some other cathartic is given to remove the dead worms from the intestines.

One of the most dreaded diseases of mankind is leprosy. It is now believed that it can be cured by

FIG. 128. With a microscope we can see whether or not malaria germs are in the blood. This picture shows several red blood cells; two of them have malaria germs on them. The malaria germs are shown by black spots. Find smaller round malaria germs in the liquid part of the blood.



the oil from the chaulmoogra tree, which is known to grow only in a few places. Some explorers recently went from the United States to southern Asia to search for other places where these trees may be growing, so that we may have more of their oil to use in testing its value as a remedy for leprosy.

How the body fights disease. Most of our communicable diseases cannot be cured by drugs, however. Doctors often give us drugs or medicines, but usually these medicines are not intended to kill the germs of a particular disease. They are mainly to help the body by stopping pain, stimulating the heart, or making it easier to digest food.

Often all the doctors can do is to help the body in a general way. They may send us to bed to rest the body or prevent our becoming chilled; they may give us a light diet, or one that is easily digested, such as milk, so that the body will have less work to do. They may give us medicines to make us sleep, or to make us perspire, and so lower the body temperature. If the body is helped in such ways as these, it is better able to overcome its weaknesses or to fight the disease germs that may be trying to grow in it.

How the white corpuscles help fight disease. Disease germs frequently get into our bodies chiefly by way of the nose and mouth. Against such germs the



FIG. 129. These six pictures show the same white corpuscle in different stages of "swallowing" bacteria. The bacteria are the rod-like bodies above each corpuscle.

white corpuscles, which can "swallow" and destroy bacteria, stand on guard. The white corpuscles in our blood are very soft and can change their shape very easily. When a white corpuscle "swallows" a bacterium, it does so by flowing all around and over the bacterium, until finally the bacterium is inside the white corpuscle, as in Figure 129. Soon the bacterium disappears from view, because the white corpuscle has entirely dissolved it. One white corpuscle can take in a great many bacteria at a time, as many as several dozen.

Other aids in fighting disease. A second way that the body fights disease germs is by making special substances that become mixed with the liquid part of our blood. These special substances cannot be seen in the microscope, as white corpuscles can, but they can either dissolve bacteria or make it easier for the white corpuscles to kill them. In certain diseases, diphtheria for example, special substances are formed in the body and they destroy poisons from the diphtheria bacteria. The reason we get well when we have typhoid, diphtheria, pneumonia, and other communicable diseases is because the blood has a large amount of these special substances, which destroy the bacteria and the poisons or toxins which they give off.

Although we cannot see these special substances, we know that they are in the blood. If we mix a little blood from a person who is recovering from pneumonia with some pneumonia bacteria, we find that his white corpuscles will take in and destroy many more of these bacteria than the white corpuscles of a person who has not had pneumonia. If we put a little blood of a person who is recovering from diphtheria into a tube of broth in which diphtheria bacteria have been growing and making poisons or toxins of diphtheria, these toxins soon cease to be active; and if we inject this mixture into a guinea pig, it does not develop diphtheria. This shows that the patient's blood had in it some substance that worked against the diphtheria toxin. This special substance is called an antitoxin.

Some persons seem to have in their blood some

of these helpful substances "naturally," e.g., antitoxin against diphtheria, even though they never had diphtheria. If such people are exposed to diphtheria they do not develop the disease. We say that such people are naturally immune to diphtheria.

When we become ill with diphtheria, it is because we do not have in our blood enough of the special substances to protect us against the diphtheria germs. If our bodies do not begin at once to make these substances, and make enough to get ahead of the diphtheria germs, the germs will win the fight.

Forty or fifty years ago many more of the people who had diphtheria died than do now. What makes the difference? Today when people begin to develop diphtheria, the doctors inject into them a liquid that has been extracted from the blood of a horse which has had diphtheria. This liquid contains the antitoxin which works against the diphtheria toxins.

How horses are used to cure disease. A horse has so much blood that we can take enough blood from one "diphtheria" horse to treat hundreds of children. After New York City changed to the motor type of fire engines, Old Dan, a favorite fire horse, was given to the Board of Health to use in making antitoxin. He was given lockjaw or tetanus toxin, and in a few years he made \$250,000 worth of antitoxin for lockjaw.

Horses are now used to make substances (antitoxin or antiserums) helpful in the fight against several different diseases. The diseases which you know about, and against which the horse's blood is most certain

to help us, are diphtheria, lockjaw, pneumonia, and meningitis. But even in these diseases the substances in horse's blood cannot help us if we wait too long. More children with diphtheria get well if the antitoxin is given the first day of the disease than if the antitoxin is given on the third or even the second day.



FIG. 130. These horses have been used for several months to make diphtheria or lockjaw antiserum. Notice how healthy and active they still are. (*Courtesy of H. K. Mulford Company*)

Boards of health and doctors should have arrangements to get antitoxin and the other special substances in the quickest time possible.

Only the blood of healthy horses is used to make such substances as antitoxins. The blood is taken from a small vein, and handled very carefully to make sure that no germs from the air or the hands of the

workers get into it. This blood is allowed to stand until it clots, and then the liquid part, or serum, can be poured off. This serum, or antiserum, as most people call it, is kept in a cool, dark place, until it is needed to protect us from disease. Then it is usually injected into a blood vessel or just under the skin, and the circulating blood carries it around to the parts where the disease bacteria or their poisons are present.

Horses can give a great deal of blood for such purposes without being injured. All horses used to produce blood for controlling human disease are well cared for, in every way, because when their health is good their blood gives the best results. They are given exercise every day and often they are used for light work.

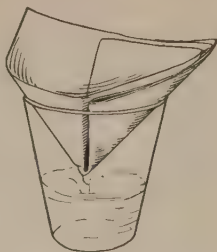
Antiserums to prevent disease. Antiserums from horses are sometimes given to well people to keep them from becoming ill. If a child has been exposed to diphtheria, the doctor may give it some diphtheria antiserum, so that it may be sure to have enough of the special substances, such as antitoxin, to overcome the diphtheria bacteria, if they are beginning to develop in the child's body.

We have not yet learned to prevent many diseases in this way; our best results have been in preventing diphtheria. Nurses and others who are nursing people ill with diphtheria often have diphtheria antiserum given them to keep them from taking the disease.

The Schick test. We can now tell which persons are most likely to take diphtheria if they are exposed

to it. We can now test all the children in a school or a town very quickly, and, if they need it, treat them to prevent their having diphtheria, and so avoid

FIG. 131. Fold a piece of blotting or filter paper as shown in the figure on the right. Boil some ground coffee in water, and pour the mixture into the folded blotter. What happens? This process is called filtering.



a possible epidemic. This test is called the "Schick test," because it was worked out by Dr. Schick.

In the Schick test, a little diphtheria poison or toxin is put into the skin of the arm with a fine syringe

FIG. 132. This bottle or flask contains very clear beef broth in which diphtheria bacteria have been growing and producing toxins. In order to separate the bacteria from the toxins, the broth is filtered as shown in Fig. 131. The bacteria do not go through the filter paper but the broth with the toxins does. This toxin-broth may be used to make Schick tests, and to vaccinate against diphtheria.



needle. No live diphtheria bacteria are used, so no one could ever get diphtheria from this test. Only a little toxin is used — not enough to injure any one,

even a child. When the toxin is put into the arm it makes a red swelling or spot, unless the person already has in his blood the special substances which can overcome or destroy the toxins which were put into it.



FIG. 133. Schick test. An inflamed swelling on the arm, after injection of diphtheria toxin, shows that, if exposed to the disease, a child would probably develop diphtheria, unless vaccinated to prevent it.

If the very small amount of toxin which is put in makes a red or inflamed spot or swelling, we know that person would be made ill if live diphtheria bacteria began to grow in his body and make toxins. A doctor can protect him from having diphtheria by vaccinating him with diphtheria vaccine.

Dick test for scarlet fever. In this test the toxin of the bacteria of scarlet fever is injected into the arm, just as in the Schick test.

Vaccinating against diphtheria. Diphtheria vaccine is made from the diphtheria bacteria. The bacteria grow for a few days in a clear meat broth, and then the broth is filtered to take out the bacteria, and to keep the bacterial poisons. This diphtheria toxin is injected into the skin of a person who, according to the Schick test, needs to be protected against the disease.

After the injection that person begins to make special substances against diphtheria, just as would be the case if he really had diphtheria. These substances may stay in his body for several years, and while they do stay, that person will not take diphtheria.

Health officers in many towns have had the Schick test given to the children to find out which ones are most likely to take diphtheria if they should be exposed to it. Then diphtheria vaccine has been given



FIG. 134. A syringe for holding vaccine or antitoxin is often marked with little lines to help the doctor tell how much he is using.

to all the children who need it, and a possible epidemic of diphtheria prevented.

Diseases prevented by vaccines. Vaccines have been prepared to prevent several other diseases besides diphtheria. In the Great War all our soldiers were protected by a typhoid vaccine. States or countries in which the people are vaccinated against smallpox have very few cases and almost no deaths. Scarlet fever vaccine is now widely used, and in several countries doctors are using a vaccine for tuberculosis.

Before Pasteur made the first vaccine for rabies or hydrophobia, many people in all parts of the world died each year from the bites of "mad" dogs.

Vaccines are called by that name because they were first made by growing disease germs in a cow. (*Vacca* is the Latin word for cow.) All the substances which

cause us to make antitoxins or antiserums to protect ourselves are vaccines.

Disease tests. Most of you have seen a doctor or a nurse use a thermometer to take the temperature of a sick person. When people are ill the body temperature usually changes; for example, it becomes very

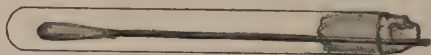


FIG. 135. This glass tube contains a cotton swab, made by twisting a little cotton around a slender stick. Such a cotton swab is used to collect bacteria from a sore throat, or to rub medicine on sore places to kill bacteria.

high when we have typhoid or pneumonia, and drops below normal in the case of certain other diseases.

The microscope (Figure 15) is also used in making disease tests. When we have a sore throat, for example, a doctor usually looks into our throat to see whether it is inflamed. But that alone does not tell

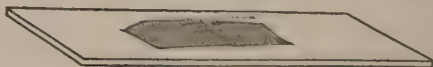


FIG. 136. Material collected from a sore throat has been rubbed on a piece of glass, so that it can be examined under the microscope. (See Fig. 137.)

him what disease bacteria may be there. To find that out he rubs a cotton swab (Figure 135) over the sore or inflamed part to collect some of the bacteria that are causing the trouble. When this swab is rubbed over a piece of clear glass, some of the material which was on the cotton sticks to the glass (Figure 136), and

can be examined under the microscope. Figure 137 shows some material from a throat as it would look

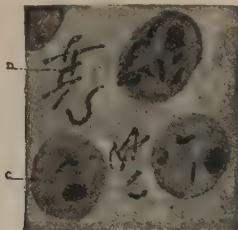


FIG. 137. The material taken by a swab from the throat of a diphtheria patient (see Fig. 136) might look like this. The large round bodies (C) are cells from the inside of the mouth. The bacteria marked D are diphtheria bacteria.

through a microscope. By this method a doctor can often tell whether or not a person has diphtheria two

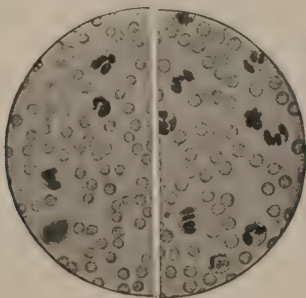


FIG. 138. The left half of this picture shows red blood cells or corpuscles with four of the larger white ones as seen with the microscope; the right half shows a sample of blood taken when the body has made extra white corpuscles to fight bacteria in the blood.

or three days earlier than he could by merely looking at the throat, taking the temperature, etc.

Sometimes a drop of the blood from a sick person is mixed with a little substance like gelatine and put into an incubator, kept at body heat, or 98.6°F . Later small spots, or masses of bacteria, may show on the gelatine. If they do, they can be examined under the microscope to see what kind they are.

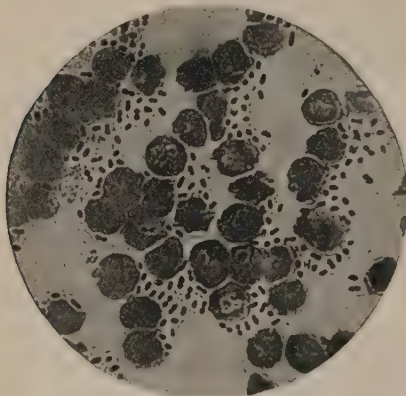


FIG. 139. In such diseases as pneumonia and meningitis, bacteria are found in the blood. This picture shows some of the red blood corpuscles and pneumonia bacteria which are still smaller. (*Williams, Brown, and Earle*)

Doctors often examine blood under the microscope to see what kind of bacteria are causing blood poisoning, or whether the white corpuscles in the blood are taking in and destroying the bacteria. Figure 138 shows two samples of blood, as they might look under the microscope, one at the beginning of a disease, and the other when the white corpuscles are increasing in number and helping to kill the bacteria which are growing in the body and causing illness.

There are many other kinds of tests which doctors now use to find out the condition of the body. If a

person has "hay fever" caused by pollen from flowers, we can find out which plant he should avoid by making a skin test with small amounts of pollen from each of the plants which we suspect cause his hay fever.

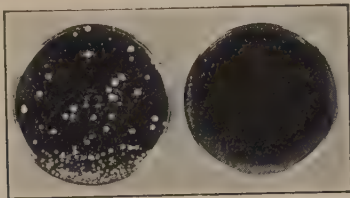


FIG. 140. In blood poisoning, bacteria get into the blood; this may be shown by a test in which a little of the patient's blood is mixed with special food material, so that the bacteria will grow into many little masses as shown in the dish on the left. If no bacteria are in the blood, no change will take place in the blood and it will look as it does in the dish on the right.

Figure 141 shows a pollen test made by injecting pollen from several different flowers into different places on the arm with a syringe (Figure 142). Which

FIG. 141. Pollen from the four plants named here was injected into the arm shown in the picture. Which made the largest inflamed spot or swelling? Which plant pollen would be most likely to give hay fever to the person who was tested?



pollen made the largest inflamed spots? Which of the plants tested would be most likely to be the cause of hay fever in this person?

Tests like these take a great deal of time and expensive apparatus. Doctors are usually too busy to make them as promptly as they should be made, and therefore there are laboratories where such tests can



FIG. 142. Syringe used to give vaccines, for typhoid, diphtheria, etc.

be made. How far away is the nearest laboratory of this kind? Ask your doctor or school nurse to tell you what kinds of tests are made there.

Diseases of farm animals that affect human health. Certain diseases of our farm animals may affect human health. Milk or meat from cows with tuberculosis may give us that disease, unless the milk is pasteurized or the meat is very thoroughly cooked. It should be illegal in every state to sell meat or milk from tubercular animals. Every farmer should try to keep his cows free from tuberculosis, and when he buys a cow he should have her tested to find out whether she is free from tuberculosis. This test could never give tuberculosis to the animal, as only dead tuberculosis bacteria are used.

Hogs sometimes have a disease caused by the parasitic worms known as trichinas. These may get into human muscles if we eat raw pork or pork that is not thoroughly cooked. See page 34 and Figure 124.

Pigs also often have tuberculosis, and therefore all

pork products should be thoroughly cooked before being eaten.

Foot-and-mouth disease in cows may cause serious illness in children. This disease is very easily spread, and when it appears, health officers quarantine the area.

Many cases of undulant fever in the United States have been traced to the milk of infected cows. Malta fever may be transferred by goat milk. These facts suggest that milk should be certified or pasteurized.

How we can prevent the spread of communicable diseases. Look through the table at the end of this chapter and notice how many of the diseases that affect children are spread by material from the nose and throat. Measles often begins like an ordinary cold; diphtheria and scarlet fever may at first seem like a sore throat. Very often, therefore, children who are "coming down" with one of these diseases may spread the germs of that disease by careless habits, such as putting things, that other people handle, into their mouths, or handling food, cups, etc. with fingers soiled with saliva or material from the nose or handkerchief.

When you have a cold or sore throat, be careful not to kiss any one, especially little children. Instead of wiping the dishes or helping set the table, etc., do some other kind of work until you are well. Is it kind or thoughtful to visit others when you have a sore throat or a cold? Should you go to a party or even to school if you think you are "coming down" with an illness?

Another way in which we can help prevent the spread of communicable diseases, is by being careful

to obey the Board of Health rules for quarantine or isolation. We should follow the doctor's directions regarding the proper care of dishes, bedclothes, towels, etc. When the doctor orders that the sick person be isolated, we should allow only the people who care for him to go into the room or rooms where he is. The nurse or person who cares for him should be careful not to carry any of the germs to the other people in the house. She should obey the doctor's rules about disinfecting her hands every time she leaves the sick room, and about wearing a special dress or big apron which she does not wear outside the sickroom.

Children who have been ill and have almost recovered can help by obeying all the rules about leaving the sickroom, even though they feel almost well, because there may still be some germs left which they can give to other people. For this reason doctors now order that patients be disinfected as described in the next paragraph.

Disinfecting the patient. In many diseases, such as those given in the table on pages 282 and 283, special attention should be given to the patient to make sure that he does not spread his disease germs after he has apparently recovered from his illness. For this reason, we often disinfect the nose and throat and sometimes the whole body. To disinfect the nose and throat, wash them with a solution supplied by the nurse or doctor for that purpose. A solution easily prepared in any home is made by dissolving one teaspoonful of salt and a half teaspoonful of baking soda in

a glass of warm water. Rinse the mouth and gargle the throat with this disinfecting solution. The nose is most easily disinfected by using the solution in an atomizer.

To disinfect the body, it is necessary to wash the hair, take a complete bath, and put on fresh clothing — clothing which has not been worn during the illness or which has since been washed in boiling hot water and ironed.

Table of communicable diseases. The table on the following pages has been prepared to help you and your parents do all you can to prevent the spread of certain communicable diseases which often cause death or prolonged ill health. The eight diseases included in the table are the ones which are the most common among school children. With the exception of colds, they are often called “children’s diseases,” because there are not many cases among adult people. The fact is that many adults may have these “children’s diseases” if they did not have them when they were children, or if they had them in a mild form. As a rule, people who have had a severe attack of any one of the “children’s diseases” in childhood are protected or made immune against future attacks. You have already learned why this is so.

Many parents think that their children are sure to have mumps, measles, etc., some time, and therefore do not try to keep them away from children who have such diseases. But you are not apt to catch these diseases if you keep away from persons having them, during the “period of danger to others.”

DISEASE	TRANSFERRED FROM PATIENT BY	DISEASE APPEARS	SYMPTOMS
COLDS	Discharges from nose and throat	In 1 to 5 days	Running of eyes and nose, coughs; often headache and fever
WHOOPING COUGH	Discharges from nose and throat	By 14th day	Cough, with "whoops"; worse at night; vom- iting common
MUMPS	Discharges from nose and throat	By 15th to 22nd day	Pain, angle of jaw on opening mouth; neck glands swollen
CHICKENPOX	Discharges from nose and throat	By 11th to 21st day	Rash of small pimples by second day; filled with fluid later
MEASLES	Discharges from nose and throat	By 15th day	Cold in head, running of eyes and nose, sneezing and fever. Reddish spots may disappear if chilled
SEPTIC SORE THROAT	Discharges from nose and throat; (often by infect- ed milk)	In 1 to 3 days	Sore throat and weak- ness. Throat red- dened; often patches
SCARLET FEVER	Discharges from nose, throat and ears; (often by infected milk)	By 7th day	Headache, sore throat, often vomiting. Fine, even rash, especially neck and chest
DIPHTHERIA	Discharges from nose and throat	In 2 to 5 days	Sore throat and fever; back of throat, ton- sils, and palate may show patches

PERIOD OF DANGER FOR OTHERS	AFTER EFFECTS
Until recovery } and nose and throat disinfected	Often leads to sore throat, ear infections
For eight weeks or one week after last "whoop" } and person disinfected	After effects may be very severe; very "catching" first two weeks. Often fatal to young children
For one week after swelling disappears } and person disinfected	Very "catching". Usually no after effects.
At least 12 days; until all scabs disappear } and person disinfected	Usually mild with no after effects
At least 7 days; until recovery } and person disinfected	After effects often severe; very "catching" for 3 days after symptoms shown. Very dangerous for small children
Until recovery } and nose and throat disinfected	Often leads to serious infections of heart or kidneys
At least thirty days and until all discharges cease } and person disinfected	Illness and after effects both dangerous, though attacks may be very light
Until no diphtheria bacteria found in throat } and person disinfected	Illness and after effects both very dangerous; mild cases often not recognized

TEAM WORK

Choose leaders and organize two health teams. Contribute your suggestions to the list which your team is making.

1. What can a well person do to prevent illness?
2. What can a sick person do to prevent the spread of disease?
3. Use the following suggestions in planning for a health slogan contest or a health poster display. Add other rules if they seem to be necessary.

Rules: The ideas must be based on Chapter VII. The slogans or posters must encourage people to form health habits or help people to keep well.

THINGS TO MAKE UP

1. A play that shows how a sick child helped himself to get well.
2. A story that shows how a boy "caught" a disease.
3. Some half-finished health stories for other children to read and finish.
4. A health game.
5. A puppet show or a pantomime about a little girl who made herself and others ill.
6. A dialogue in which you talk about the queer medicine used by primitive people.
7. Some health riddles, charades, and puzzles.

NOTE: Perhaps you can plan a health party or entertainment in which you can use the things you made up.

NEW HABITS FOR OLD

The best way to get rid of a bad habit is to build a good one in its place.

Grease a sheet of paper in the middle. On the left of the crease list habits that endanger health. On the right side of the crease, write the things that would seem to belong there.

CHAPTER VIII

IMPROVING COMMUNITY HEALTH AND WELFARE

Importance of community health and welfare. Health in home and neighborhood, as the first seven chapters of this book have already shown you, depends upon the food supply, diet, the water system,



FIG. 143. A house in a lonely mountain region. Thousands of people in America still live in such log cabins. (Courtesy of Lincoln Memorial University)

the heating of buildings, the disposal of garbage and sewage, and many other things which are necessary for life in a civilized neighborhood. Many of these are so important that each neighborhood or community, whether in city or country, has local regulations in

tended to help secure healthful living conditions for its people. Each state has many laws which were passed by its own legislature for the purpose of improving the health and welfare of people within its boundaries and the Federal Government of the United States has laws made by the Congress which relate to the health and welfare of the country as a whole.

Coöperation of each person needed. There are, however, a great many things which each one of us, even the youngest, can do to help make our neighborhood a more healthful place to live. Many of these things we must do for ourselves. For example, the health department can make sure that the water which comes into a city is pure and safe water, but no health or police department can make sure that each one of us washes our hands before handling food to be eaten by ourselves or other people. A state legislature may pass laws to prevent the sale of adulterated foods, but no state law can make people eat properly, select foods rich in minerals and vitamins, avoid overeating, etc. The Congress may make laws designed to prevent strong alcoholic liquors and other harmful substances, such as opium, from being brought into our country, or shipped from one state into another, but no federal or state law can of itself keep some people from using alcoholic substances or drugs which have been smuggled into the country, nor would it be possible for our government to have enough officers to prevent some people from trying to smuggle such pro-

hibited substances into our country. Our government can do its best to enforce such laws, but it has no direct way of influencing people to obey or observe them, although it has the right to expect that all good citizens will do so.

The health or welfare of any community depends not only upon the laws and regulations that exist, but



FIG. 144. Would it be easy or difficult to keep a one-room house like this clean? (Courtesy of Lincoln Memorial University)

also upon the coöperation of the people themselves. Many persons seem to forget that the laws were made to help the people of a community or a state make living conditions better for every one, and in this way improve the general welfare. When, occasionally, a law seems to interfere with our own desires, we should stop to consider the beneficial effects of that law. For example a man in a city who wants to keep a pig or a cow in his yard may find that he cannot do so because

there is a law for that neighborhood which forbids the keeping of pigs and cows in such crowded communities. The man may feel that such a law is a "hardship" to him, but since it is almost impossible to keep such animals in a city without attracting flies and making disagreeable odors, it is a very good law for the whole community, and even for that man himself.

Our health laws and regulations should have our hearty coöperation for another reason. Each one of us can do many things to help make our neighborhood a safe place in which to live and keep our friends and families well. A fire company may be called to put out a fire, but it cannot be on hand to prevent any fire that might start. The city ambulance may be called to take an injured person to a hospital, but often the quick eye and mind of some one on the spot might have prevented the injury. The police may form a line to keep people away from a burning building or from an injured person, but they cannot always keep us away from dangerous places or communicable diseases. This we must do for ourselves.

Helping others avoid accidents in your home and neighborhood. There are hundreds of thousands of preventable accidents in the United States every year. Most of them are due to somebody's carelessness. Make a list of careless things you have seen people do and which you think might have caused accidents.

If you have read this book thoughtfully, you will be ready at every opportunity to help prevent accidents in your neighborhood and be helpful to others

in every way possible. Be on the lookout to help others as follows:

1. Keep little children away from stoves or hot liquids which may burn or scald their delicate skins. What dangers from burns and scalds have you seen or heard about?

2. Help your playmates to understand why it is dangerous to play around railroad yards, or jump on



FIG. 145. How can you help others to avoid such accidents on thin or soft ice? How does the board make it easier and safer for the boy to get near the child in the water?

or off trains which stop at a switch, or walk on tracks and trestles between stations. What is the law about playing on the property of railroad companies? What warning signs are posted on or near railroad property?

3. Do not be a coward and go with others on soft or thin ice just because other boys or girls "dare" you to do so. Help them to see why you refuse and perhaps it will never be necessary for you to use the method shown in Figure 145 in order to rescue one or more of your foolhardy friends.

4. If you see a hole or thin ice on the skating pond,

put up a danger signal, such as an old barrel or a pole with a red rag.

5. Make yourself a special fire guard. Look out for young children, especially those with loose clothing, if you see them near a bonfire. Put out every fire which you think may do damage to property or to people. Start some other game when you see children running with burning sticks. Ask the police of your town if there is a law about making or leaving fires. Do you know how to build and put out a camp fire, or a fire running in dry leaves or grass? Do you know how to act if a child's clothing is on fire?

6. How can you help others avoid falls: on icy sidewalks? on fruit peelings, such as banana skins? over objects left where others will walk in the dark? down into uncovered holes, cellars, etc.?

7. How could the officials of your town or city teach the boys and girls and adults that it is dangerous to cross streets in the following ways: (a) "Jay-walking" which means crossing the street in the middle of a block or where the traffic rules say people should not cross. (b) Crossing diagonally at a crossroads or where two streets cross. Of course, that way is shorter, but you should remember that a chief of police once said, "It is also a shorter way to the hospital and perhaps to the cemetery." (c) Crossing without looking both ways, and without looking for cars coming around the corner. (d) Crossing without looking for automobiles when stepping from behind cars and vehicles. (e) Crossing by dodging between moving automobiles.

(f) Crossing when the signal or the traffic officer says "Stop."

Crossing streets in these six ways causes most of the accidents to pedestrians in American cities. The only way to reduce such accidents is for people to be more careful when they walk across the street. In numerous cases the automobile drivers are not to blame when accidents occur at crossings, because as a rule the great majority of drivers are trying to obey the law at crossings.

You are a member of the community. Do your part in helping to prevent crossing accidents. Perhaps the following slogan will help people remember what they should do. Say it as rapidly as possible five times: "Cross crossings cautiously on crosswalks only." Always depend upon your own vigilance and alertness to keep yourself and others out of danger.

The following notice appeared recently in a Chicago newspaper. Read it.

IN CHICAGO IN ONE YEAR

214 children were killed by autos.

13 children were killed by street cars.

10 children were killed by horse vehicles.

Thousands were badly hurt — hundreds were crippled.

(Every American city had a similar record of accidents to children last year.)

Do you think that if the children of Chicago had observed carefully what is taught in this book about crossing streets and general watchfulness for their safety, this notice would have been different? If you

do not exercise all possible care to avoid accidents, you are really selfish, because an accident to you means that your parents and your brothers and sisters must suffer as well as yourself because of your carelessness.

8. Do you think you could make your playmates see the danger in the following kinds of play: "hooking" rides behind a street car, automobile, or other vehicle with a sled, wagon, roller skates or roller coaster; playing in the road or street; running after a hat or ball without first looking both up and down the street; or riding a bicycle on a busy road without holding to handle-bars, or with another boy on the handles?

9. If you have already learned to swim, be a life-guard for younger or weaker persons: (a) Keep them out of water that is over their heads; (b) Don't let big boys tease little ones by "ducking" them or in any other way interfering with their pleasure when in the water. If you are not able to enforce this rule alone, get other boys or an older person to help you. If necessary, ask some man, such as a police officer, to warn any "big bully" who continues to annoy smaller or younger boys. (c) Put up signs if there are dangerous spots where people go swimming. (d) Warn those who do not appear to know where there is a deep hole, a swift current, an undertow, hidden rocks, quicksand or mud, cold currents that may cause cramps, or any other peculiar conditions in near-by bathing places which expert swimmers in your neighborhood regard as dangerous.

10. Help avoid boating accidents. Small rowboats and canoes are dangerous crafts for persons who do not know how to manage them and who do not know how to swim. Here are some rules you will need to remember if you are going to be able to help others: (a) Don't change seats or stand up in any small boat which has a round bottom. Don't let any one "fool" in a boat, for example, pretend to capsize it. (b) Don't dive from the side of a small boat. (c) Don't try to climb in over the side. (d) Don't try to pull some one into a small boat; better let him hold on to the stern end of the boat until you row to shore, a dock, or shallow water. (e) Don't overload a boat. (f) Don't take others who cannot swim or help manage a boat until you are expert in swimming and rowing, or sailing, and also know what to do if a boat becomes overturned or if some one falls into the water. (g) Don't go out in a small boat if the water is rough or a storm is coming.

11. Boys, and even girls, who live in regions where people shoot wild game should know how to handle firearms with safety. If you handle firearms you should remember and practice the following: (a) You can tell whether a gun is loaded only by looking into the breech of the barrel. (b) Never let the muzzle of a gun be pointed towards yourself or any one else. (c) Never carry a gun with the hammer set ready for firing. (d) Never shoot at any object unless you see it clearly and are sure that there is no person or tame animal in line. (e) Be careful if you go into the woods

during hunting season; some reckless hunter who does not know the rule in (d), above, may shoot at you.

12. Keep little children away from guns, pistols, sharp-edged tools, etc. They do not know how dangerous these things are.

13. Learn all you can about the possible dangers in our daily use of electricity, and then help others avoid accidents from this source. Chapter V, on light, will give you some of the most important rules for avoiding such dangers.

14. Borrow from a library a copy of the *American Red Cross Abridged Textbook on First Aid*, and look over its pages so that you will know how to use this book when you need help in case of accidents. It is a useful little book and should be in the medicine closet in every home.

15. There are many kinds of public property in your town or city which were made for the convenience and health of all the inhabitants. You will, therefore, be helping to improve the health and welfare of the community if you coöperate with others in preventing damage often done by boys and others who should know better than to throw stones at street lamps; break shrubs and steal flowers in the parks; do damage to school property (such as cutting their initials on desks and woodwork); break or make unclean the plumbing fixtures in public washrooms; throw papers, peanut shells, and fruit skins on sidewalks and other public places; steal or change signs intended to warn or direct people.

The health of hired workers. Some of the most important laws and regulations in each community relate to working conditions, such as the number of hours of work per day, the safety of buildings in which people work, the age at which children may begin to work for pay, the dangers which come from handling poisonous chemicals, working with dangerous machinery, etc.

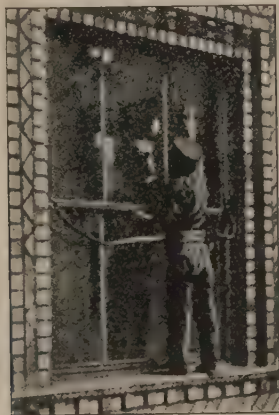


FIG. 146. Men who clean windows on tall buildings are required to fasten their safety belts before they begin work. (*Industrial Hygiene Bulletin*)

Anything which affects the health of the worker makes him not only less valuable to the neighborhood but also may cause him or his family to become dependent upon the community for support. Every community should therefore look after the health of its workers.

The idea that "it pays" to protect the health of the hired worker, because he is more useful when he

is well and may be an expense when he is sick, is a selfish way of looking at the problem of protecting the health of workers. The other and more humane way of looking at this problem, is from the unselfish point of view of those who believe that everybody in the community has a right to health and happiness, and therefore the health of hired workers, as well as that of all other people, should be protected in every way possible in order that everybody in the community may be as healthy and happy as possible.

Can you think of good reasons for such laws as those listed below? Ask your parents or teachers to help you find at least one way in which such laws if obeyed or enforced will improve the health of the worker and therefore the welfare of the community:

1. Workrooms must be well supplied with artificial light if sufficient daylight is not available.

2. Saws and other dangerous machines must have guards.

3. Fans must be used to draw dust away from machines which make a great deal of dust.

4. Children under sixteen years old must not be employed for full working days.

5. All buildings over three stories high must have fire escapes.

6. Wood alcohol must not be used where the fumes may affect the eyes.

7. Heavy weights must not be lifted by women and children.

8. Accommodations for washing the hands before eating must be provided for workers who make or use lead paints or other poisonous substances.

9. Scaffoldings must have guard-rails.

10. Doors in all factories must open outward.

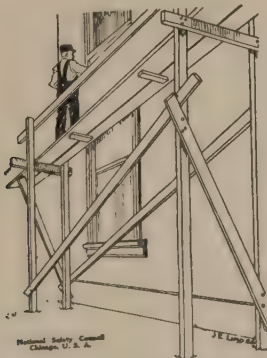


FIG. 147. Notice the guard-rail which will help keep this man from falling if he steps backwards or stumbles. Why should cities and states have rules for making scaffolds safe? (Courtesy of National Safety Council)

11. In constructing tunnels under rivers, men work in places which contain compressed air. This makes breathing very difficult and such workers must work in shorter shifts (e.g. four hours at a time).

12. Smoking is prohibited in factories where there are inflammable gases or other substances. (Name some such.)

13. Women and children must not be employed late at night.

Find other such laws which apply to work done in your neighborhood.

Why we should coöperate with officials who enforce the laws for public welfare. We are in the habit of thinking that the chief duty of policemen and other officers who enforce laws is to arrest those who break them. We forget that the most important work of these officials is helping the inhabitants obey the laws made for the welfare of the community.

We should remember that the welfare of the community means the welfare of a majority of people. There are always some people who do not wish to obey laws which interfere with their selfish desires. For example, there are people who object to being quarantined when their children have communicable diseases; and there are others who want to run their automobiles fifty miles per hour. Such people, who disregard the health and safety of others, must remember that laws were intended to promote the welfare of the majority of inhabitants, and that in a democracy, like the United States, the majority have the power of making laws which control everybody. Those who do not like the laws which are best for the welfare of a majority of people should remember that if they are going to live in this country they must adapt themselves to the laws that are best for the community as a whole, not for certain selfish individuals.

Since it is the duty of judges, police officers, sheriffs, and other officials to help us obey the laws which are intended for the common welfare, it is our duty as good citizens to coöperate with them in every possible way.

We should always remember that the police officers of city, town, or other community have no personal interest, except that of the good citizen, in enforcing the laws for our welfare; but, like good soldiers, they are simply obeying orders. These orders are the laws made by our representatives who are sent to the legislature or to the Congress by the votes of the majority of voters. Thus the laws for our welfare express "the will of the people," which means the will or wishes of the majority of people.

Public officials who protect health. In the Federal Government and in every state, county, town, and city there are public officials whose duties in the service of the people include work that directly or indirectly concerns health in home and neighborhood. You have no doubt heard of the United States Public Health Service, with headquarters in Washington, D. C., and branches in several large cities; of the state boards of health which have offices at each state capitol; and of local boards of health and health departments. The names of these indicate that they are working for health; but there are many other official departments which help protect health. In the large cities there are the following bureaus or departments which do work that concerns community health and welfare: health department, education department, water and sewer department, police department, fire department, child welfare department, park department, building department, markets department, and street department. How many of these are in your

community? If you can, find out how the work of each department affects the health of the community? your health?

In your community or town, who orders a quarantine or the closing of schools when there is an epidemic of children's diseases, such as scarlet fever or measles? Who looks after the public water supply and the sewers? Who inspects buildings? Who supervises the care and cleaning of streets and roads? Who enforces the law? Who inspects foods offered for sale? Who enforces the laws which forbid sale of intoxicating liquors and habit-forming drugs, such as morphine?

Work of the health department. In most small communities the workers in the fire departments and the police departments are paid for their services, but the workers in the health department are not. The work of the health department is so important and includes so many kinds of work that our citizens are beginning to realize that it needs well-trained workers, and that we must expect to pay for such service if we are to have those who can do the work well and can give to it all the time necessary.

Only those specially trained for the purpose know the best methods of purifying water, ventilating and heating public buildings, or disposing of sewage. Many communities waste each year many thousands of dollars by adopting plans which trained experts could have told them would not suit their needs, even though they were successful in other places.

How many members are there in the board of

health, or health department, where you live? How often does the board of health hold meetings? What is the work of your health department?

The health or sanitary regulations demand also the coöperation of each one of us, if our health is to be improved. Find for each regulation in the following list one good reason why health departments make such rules for our protection.

1. Cows and pigs must not be kept within the city limits, or near dwellings in small towns.
2. All communicable diseases should be reported at once to the office of the board of health, or the health officer, if there is no special office for the board of health.
3. Children detained from school by illness must have a doctor's certificate before returning to school.
4. Broken sewers must be reported and repaired promptly.
5. Food exposed for sale in bakeries must be screened from flies and protected from dust.
6. Children must be vaccinated against smallpox before attending school.
7. Dogs and cats must be kept out of markets, grocery stores and bakeries.
8. People who sell foods to be eaten without further cooking must be free from tuberculosis.
9. Milk must be sold in licensed places only.
10. All house toilets must be connected with the city sewer system or, in towns, with an approved septic tank system.

11. Cooks and waiters must have a health examination twice a year.

12. Diphtheria antitoxin must be supplied free of charge to any one who needs it.

Health centers, clinics, and hospitals. Besides caring for the health of people in the ways suggested in



FIG. 148. Children being brought to one of the many health centers conducted by the Henry Street Settlement, New York City.

the preceding list, some communities have health centers, clinics, and hospitals to aid in such work. These may be owned by the community or they may be conducted by private organizations, such as the Red Cross, churches, and medical schools, under the supervision of the community.

Clinics for advice to mothers about the care and

feeding of little babies are now quite common and they do more good than we can express in words. They save thousands of babies every year, and improve the health of many other thousands greatly. Many of the health centers have day nurseries for little children, and also clinics where children may be examined, and those who are ill or undernourished given the proper medical treatment or a special diet. Many hospitals have such clinics, but every community, even if it has no hospitals, should make sure that every child, and grown person as well, should have the opportunity to get good medical advice and treatment.

Communities which cannot separately afford good nurses, doctors, oculists, and dentists to care for the people who need advice and help should club together. In that way each community could hold clinics one or two days each week, and look after the people whose eyes, ears, noses, teeth, diet, etc., need attention. In several different parts of our country, communities are also combining to support hospitals for those who are actually ill; and in some cases as many as six or seven towns share in the management and cost of one hospital. This means that the inhabitants of each community have better medical and hospital service than they could have otherwise.

Housing conditions we should control. All wide-awake communities have building regulations which help make better living conditions, especially for the poorer people, who cannot always afford to move to

a better place when the house in which they live is not healthful.

Some of the building laws provide that only fire-proof buildings shall be built in crowded parts of the city or near dangerous places, such as garages and factories. Other laws aim to insure sufficient light and air, by



FIG. 149. One of two rooms in which this large family lives in one of the old tenement houses in New York City. Could the health rules taught in this book be applied in such a home? (*Courtesy of Henry Street Settlement*)

preventing the building of rooms which are very small, or which have not at least one good-sized window opening on a courtyard or street.

In cities where houses are likely to be crowded too close together, the building laws sometimes prevent building on more than three-fourths of the lot or plot of ground. In cities, too, we usually find regulations

which limit the height of buildings which can be built without fire escapes or which are not built of fire-proof materials. Where there are many apartment houses, we usually find laws which make the owners responsible for the proper lighting of the halls, for providing a sufficient number of bathrooms and toilets



FIG. 150. Homes in a crowded tenement block. Even these children could make conditions a little better by having a "clean-up week."
(Courtesy of the Henry Street Settlement)

in light and convenient places, and for heating the rooms in cold weather. There are special regulations, also, for houses, for schools, churches, stores, and factories.

The National Safety Council has prepared the following table for the inspection of homes with reference to fire hazards. Answer each of these questions for

your home. Are there any conditions there which you should and can change to make your house pass this inspection?

HOME INSPECTION BLANK*

1. Name.....Town.....
Street and Number.....
2. Is there any rubbish, old papers, broken furniture, etc. in the attic?
3. In the basement?.....
4. In the yard?.....
5. Are floors under stoves protected by metal or otherwise?....
6. Are walls, ceilings, and partitions protected from overheating of stoves, furnaces and pipes?.....
7. How do you dispose of your ashes?.....
8. Do you keep your matches away from heat and out of the reach of children?.....
9. What is the material of the house and of the roof?.....
10. Is the foundation of the house enclosed?.....
11. Are the chimneys in good repair?.....
12. When were they last cleaned?.....
13. Do stovepipes pass through attic or closets?.....
14. If there are any unused stovepipe holes, how are they covered?.....
15. Do you ever keep or use gasoline in the house?.....
16. Do you use a gasoline or kerosene stove for any purpose?....
17. How is your house heated?.....
18. Are any gas connections made with rubber tubing?.....
19. Name all the purposes for which kerosene is used in your home.....
20. Do you use a "dustless" oil mop?.....If so, where do you keep it when not in use?.....

* Approved by the National Board of Fire Underwriters. Printed here by permission of the National Safety Council.

21. Do you use electric flatirons?
22. Name any other fire hazard in or about your home.....
.....
23. Have you any fire-extinguishers?.....
24. Where is the fire alarm box nearest your home?.....
25. Do you know how to turn in an alarm?.....

What the fire department does to protect life and health. We usually think of a fire department as intended to put out fires and thus save buildings and other property. This is in part true. But in the cities, especially, some of the most important work of the firemen is saving people from serious injuries and death when big buildings burn. Some very thrilling rescues



FIG. 151. Valves like this are placed on water pipes near the ceilings of stores and factories and in the basements of buildings. If a fire starts, the heat soon melts the piece of soft metal which holds the valve in place. Then, as the valve is pushed out, the water sprinkles the room.

of people in burning buildings are made every year by the firemen in New York, Chicago, Philadelphia, and other large cities which have tall factory buildings or apartment houses.

We have often read in the newspapers of firemen who have caught children in a fire net when they were tossed from burning rooms; of others who have carried women and children safely down ladders ninety feet high; and of still others who have climbed from window to window at dizzy heights to save the lives of others. These daring acts by firemen are always

performed for the purpose of saving people, usually women and children, from injury or death. No fire chief would let one of his men take the risk of losing his life simply for the purpose of saving property, but there are thousands of firemen who forget their own danger and take any risk if there is a chance of saving some one in a burning building.



FIG. 152. This shows two sprinklers, like the one shown in Fig. 151, which began to spray water when a fire started below them.

There are no braver men in America than the firemen who are ready to rescue persons from burning buildings. Many of these men have been awarded medals in token of their heroic work. What should be the attitude of good citizens towards firemen?

Every well-equipped fire department has apparatus for saving human life. There are many kinds of ladders, some of them mounted on automobile trucks equipped with special machinery for raising them.

There are life-nets for catching persons who jump from windows or are tossed by firemen. There are gas masks for the use of firemen who must go through smoke or gases when making rescues. And there are several kinds of special apparatus for restoring artificially the respiration of persons who have been overcome by smoke or gases. Such machines often save life when the artificial respiration method, shown in Figure 79, would have failed.

In addition to their work in connection with fires, firemen stand ready to help in many ways in which their fire apparatus is useful. For example, firemen frequently rescue children or mentally sick people who have climbed into dangerous positions, and persons who have fallen into big sewers.

Can you mention any case in which firemen have saved people from injury or death?

The importance of fires in relation to health was emphasized by President Coolidge in his proclamation designating October 9, the anniversary of the disastrous Chicago fire, as National Fire Prevention Day. He said, "Although gratifying efforts are being made to lengthen the lives of our citizens and to conserve our diminishing store of natural resources, the nation's annual loss in life and property due to fire continues to surpass that of any other country. It is reported that 15,000 American lives, and property valued at \$500,000,000 were lost in fires during 1923.

"The problem of combating this stupendous waste is of national importance. If it is to be diminished,

special effort must be made to educate the public mind and conscience to the necessity of improving building construction, increasing protective equipment and fostering a spirit of national carefulness. The preservation of thousands of lives and valuable property is a task worthy of our constant endeavor and wholesome coöperation."

How the police department promotes health and welfare. Although all the efforts of police officers to enforce the laws affect the welfare of the people in a community, some of them are directly related to our health and well-being. One of the most important of these is the safeguarding of children on the streets, and especially at crossings. In spite of this careful attention, many children are injured and killed; but many more would be, if the police officers were not on guard, especially when children are going to and from school. No doubt you realize this and try to help the officers by obeying their signals and directions which are intended to protect you.

Another way in which the police protect health is by enforcing the laws regarding the handling or sale of food. In the large cities there are special inspectors for this work, but in many places the regular police officers are the only ones with authority to deal with those who disregard the laws or regulations covering these matters.

There are dozens of laws and local regulations for the control of persons who live or act in a way that may be injurious to matters of health, such as by

throwing garbage in the gutter, spitting on the sidewalk, street cars, etc., and making disturbing noises at night. It is the duty of the police department to enforce all such laws and regulations.

Now and then we read in newspapers of the heroic work of policemen in some great emergency, such as a big fire, the running away of a horse on a crowded street, or the rescue of some one about to drown. There are thousands of such brave deeds on record, and many policemen have been awarded hero medals. The police officers and the firemen are the most helpful of the public servants who protect life and health in our towns and cities.

Other things important to health. Besides those which we have already mentioned in this book, there are many other things which may affect our health, some of which are in the following list. Read carefully the items in this list and find out just what regulations govern them in your community. Should any of these regulations be changed, to help make living safer and pleasanter?

1. Heating street cars in cold weather.
2. Repairing broken sidewalks.
3. Lighting the streets.
4. Providing safety zones for street cars and busses.
5. Operating motor busses.
6. Selling tobacco and cigarettes to minors.
7. Installing smoke consumers.
8. Making unnecessary noise, especially at night, or near hospitals.

9. Cleaning the streets.
10. Oiling roads to keep down dust.
11. Licensing soda water stands, sandwich stands, etc.
12. Obstructing the highways (building supplies).
13. Selling alcohol.
14. Selling dangerous drugs.
15. Licensing farms or dairies to sell milk.
16. Licensing the drivers of motor cars or taxicabs.
17. Ventilating motion picture houses, theaters, factories, stores, etc.

Can you add three more items so as to make twenty in this list? What regulations govern these three items in your community?

Outdoor recreation and health. The leading doctors in America now say that in order to keep healthy we must have recreation out of doors. This is especially true for children. The reasons for outdoor recreation are, first, that sunlight has a beneficial effect, which has been described in the chapter on light; and second, that outdoor play is restful, makes us more cheerful, leads us to take more exercise, and gives us a feeling of good health.

Outdoor recreation is becoming more popular every year in America. Many towns and cities have playgrounds equipped with the kinds of apparatus that children like. Many communities have playgrounds, tennis courts, ball fields, skating ponds, croquet grounds, swimming pools, running tracks, and golf courses which give opportunity for recreation for children and also for older people.

Fifty years ago such recreation would have been regarded as wasteful of time that ought to be spent in study and work, but now the doctors know that everybody needs outdoor play and recreation for at least two hours every day.

In some of the countries of Europe the children do not know how to play group games as we do in America.



FIG. 153. These children from the poorest district of a big city are having a "fresh-air vacation." Some of them have never seen flowers in a field before. Why should every city have parks open to all? (*Courtesy of Henry Street Settlement*)

In Belgium all the boys and girls know only one such game, which is a sort of ball game in which the players take sides and the ball is thrown from one side to the other. Realizing that the children in Belgium need more play, the American Junior Red Cross has organized playgrounds and appointed teachers to help the children learn how to play in groups.

The children of the country and villages in America

can find plenty of places to play most of the games that interest them. It is quite different in the larger towns and great cities of America. Tens of thousands of children have no place to play except city streets such as are shown in Figure 150. There are a few places for play in the parks, but these are often too far away from thousands of homes. The place where the photograph for Figure 150 was taken is several miles from the nearest park or parts of the city where there are large open spaces for play. It would cost from ten to twenty cents carfare for a trip to these places and very few of the children who need this outdoor play the most have this much money to spend in this way.

Many children in the large cities never see the country except when they are taken on vacations by persons who collect "fresh air funds" to pay their expenses. The children shown in Figure 153 were on such a vacation when the picture was taken.

A TWENTY-MINUTE TEST

How many things can you list under each of these three headings?

1. What the state does to protect your health.
2. What you must do for yourself.
3. How your coöperation affects the health of others.

THINGS TO MAKE

1. Sketches or lists of the safety devices in your neighborhood, or in the place where your father works.
2. Cartoons about those who are too selfish to act for the welfare of the community.

3. A list of the people who help you to keep well. Under each name write down what the person does.

4. A community or neighborhood map, showing health centers, clinics and hospitals, dispensaries, playgrounds, parks and all other things which contribute to community health.

5. A Health Chart upon which you record your own health habits regularly. This chart should also show your height, weight, and age each month. Other items should be marked daily. There should be some place and way to show illness or colds, visits to the dentist, and other health events.

SUGGESTIONS FOR GROUP WORK

Elect three or more group leaders. Choose those who have done exceptional work on some of the chapters of this book. *Let each leader choose people for his group* until every one in the class has been chosen.

Have group meetings and choose one of the following pieces of group work:

1. Make a health code
2. Make a neighborhood health survey
3. Report on recent health discoveries
4. Gather health clippings from the daily papers for a week
5. Report on recent inventions which will prevent or reduce accidents
6. Report on how epidemics spread
7. Health workers and their work

You will find interesting information on most of these topics in libraries, reference works, magazines and government bulletins.

After about a week of work, each group in turn should make a report to the class. Each member of a group should do something to make the report worthwhile.

SUGGESTIONS TO TEACHERS WHO USE THIS BOOK

BY LAURA ZIRBES

The desirable outcomes of the study of this book include insight into the conditions which favor health and community welfare, habits which contribute to healthy living, permanent attitudes which guarantee coöperation in health measures, and interests which enlist initiative in the betterment of living conditions. These outcomes can hardly be expected from a formal, didactic assignment and recitation of facts. Much of the value of the book depends on the way in which it is used. The very approach or introduction should enlist interest and lead pupils to see how their own experiences and needs are taken into account.

Numerous concrete illustrations of this type of approach may be found in the "Suggestions to Teachers" in the first book of this series. Familiarity with the first book is almost prerequisite to a realization of the values of the suggestions which accompany this book.

Nevertheless certain brief recommendations may be well worth restatement in terms of the content of the eight chapters which precede these notes.

Introducing the Book as a Whole. Use a story or an anecdote to show that some people never think of health until illness is upon them. If possible get the children to list things which may have something to do with their own personal health or with the health of their families, friends, and neighbors. Then let pupils check this list with the table of contents of their new books. Give a brief opportunity for glancing at the pictures to see whether additions to the list are suggested.

Let pupils read the part of Chapter I, called "Introduction." Here in a page and a half they will get an idea of how the

point of view in this book differs from that of Book One. Let them tell more illustrative stories like the one of the boy who drank the baby's milk, the men who opposed health measures, the farmer who kept one of his cows clean, and the woman who was willing to sell what she would not eat. Let the children be on the lookout for more illustrations and tell them that there will be time for telling a few more anecdotes the next day.

Suggestions on Chapter I. On the next day begin by asking for the anecdotes. If possible use one of them to lead further into the remainder of Chapter I. In case no incident provides this point of contact, be ready with some recent personal experience or passing incident to show the need of wise selection of foods and the effects of food on health and growth. Let the children make a list of things which they would like to know about foods. Then let them read to see whether Chapter I answers any of their questions. Of course, this reading should be a mere rapid, silent, first reading of the chapter, after which, in class conference, pupils should be led to check off all the questions which have been answered by their first reading. In this connection pupils may quite naturally be led to refer to the exact page or sentence which answered a given question.

When all the pupils' questions have been answered, intimate that there are interesting suggestions at the end of the chapter. Select one which you think particularly interesting and call attention to it by number. Tell the pupils to select one or two questions or suggestions for study and give them a few minutes for work. Ask pupils to indicate on the blackboard or in some other way the numbers of the questions on which they are ready to report. Arrange for further study and for reports. Some such reports may be made in writing (Nos. 3, 6, 8, 10, 18). Other reports will be in the form of drawings and still others may best be given orally. This variety gives opportunity for grouping the reports in interesting ways for successive periods. When several pupils report on the same question there may be occasion for comparing replies and discussing

differences. Opportunities and suggestions for activity given in the body of the chapter should not be overlooked.

Thus the study of Chapter I, and reports, may proceed quite naturally for several days, during which the teacher functions as guide, helper, and interested observer.

Suggestions on Chapter II. After studying Chapter I as outlined, challenge the children to decide whether food is the most important and necessary factor in promoting health. Say that you have heard of people who died of thirst. Or connect the things which the children say to the content of Chapter II and lead them to read it to find all the ways in which water has to do with health.

While the children are reading silently, the following notice may be placed on the blackboard: "When you have finished reading the chapter, test yourself by seeing whether you can finish the ten sentences in the test given at the end of the chapter." This keeps the rapid reader profitably employed while slower pupils complete the chapter, and makes for thoughtful interpretation. Suggestions for further study and for related activities follow at the end of the chapter and need no further explanation.

Suggestions on Chapter III. For this chapter it may be well to use the suggestions at the end of the chapter as an introduction to the first reading. The purpose of the first reading would then be the selection and proposal of additional topics for two-minute talks. This provides a natural setting for training in the recognition of equivalent statements and a real need for skimming the list of twenty topics to see whether each proposed topic is already listed.

These preliminary contacts with the list of topics make the choice of a topic for a talk meaningful. The planning of informal talks gives opportunity for careful planning and the exercise of judgment and initiative.

The major outcomes of such work depend on the spirit in which it is carried on.

Suggestions on Chapter IV. This chapter is based on the outcome of recent scientific studies of the whole problem of ventilation. That accounts for the absence of certain generally accepted assumptions and beliefs which can no longer be held. The use of experiments within the chapter shows how such problems are studied and how solved. Many of the "Why" questions at the end of the chapter can be answered by experiment.

True-false statements can also be subjected to experimental test. It is entirely appropriate that children learn that argument and opinion do not alter nor disprove facts, and that experimental evidence is always preferable to unsupported personal opinion. The final suggestions which accompany this chapter recognize the fact that knowing must be carried over into doing if it is to be of real and permanent value.

Suggestions on Chapter V. The approach to Chapter V (pageant) should avoid overemphasis on costumes and properties, and prevent deterioration of preparatory work into deadly routine rehearsals with rote memorization of assigned parts. Much of the study and growth value of such work is lost when the teacher shows herself to be too deeply concerned with the "performance" values of what might otherwise be an interesting and educative activity. Most of the necessary suggestions are purposely given at the end of the chapter where they may be used by the children.

Suggestions on Chapter VI. These reports are to be made in the form of illustrated booklets. The entire plan is outlined so fully at the end of the chapter that little needs to be said here. Teachers should resist the temptation to improve the booklets at the expense of pupil initiative and enthusiasm. Far more important than the visible outcomes of such work are the changes which constructive activity brings about in the children.

Suggestions on Chapter VII. The emphasis in this chapter is on prevention. The study of the chapter should result in

insight into health habits which prevent illness and the spread of communicable disease. The formation of such habits depends to a certain extent on an appreciation of their significance.

Suggestions on Chapter VIII. The final chapter presents some new material but also gives opportunity for the recall and reorganization of material presented in the previous chapters. The "Twenty-Minute Test" suggested at the end of the chapter should not be made a formidable or fearful event. It is merely a means of securing thoughtful reorganization of the material in the chapter. It may be well to allow pupils to work on this test with their books open.

The suggestions for "Group Work" and "Individual Activities" serve to carry the interest out beyond the completion of the book itself.

In conclusion it should be said that this book provides learning situations of distinct social value. The pupils who coöperate in constructive endeavor related to general welfare are certainly acquiring desirable attitudes that are fundamental for good citizenship. It should also be obvious to those who use these suggestions that the pupils are learning to think and study to some purpose and to enjoy it.

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